Official Organ of the American Welding Society

The Welding Engineer

Edited by L. B. Mackenzie

$3.00 per year in U. S. | Reg. U. S. Pat. Office | $4.00 per year abroad

Vol. 6 | Chicago 608 S. Dearborn St. | SEPTEMBER, 1921 | New York 171 Madison Ave. | No. 9

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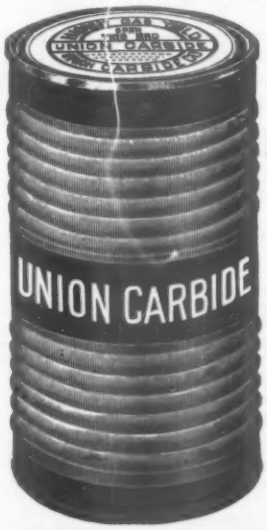

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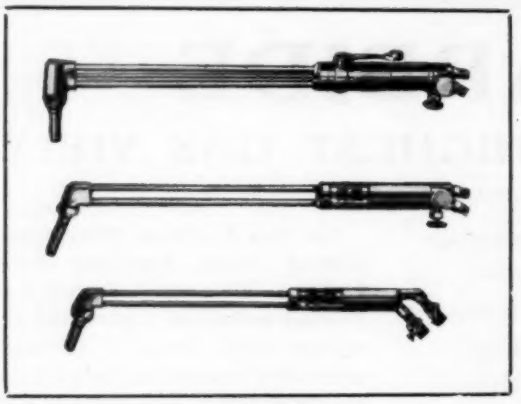

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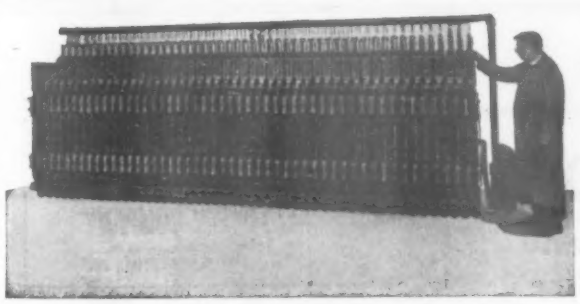

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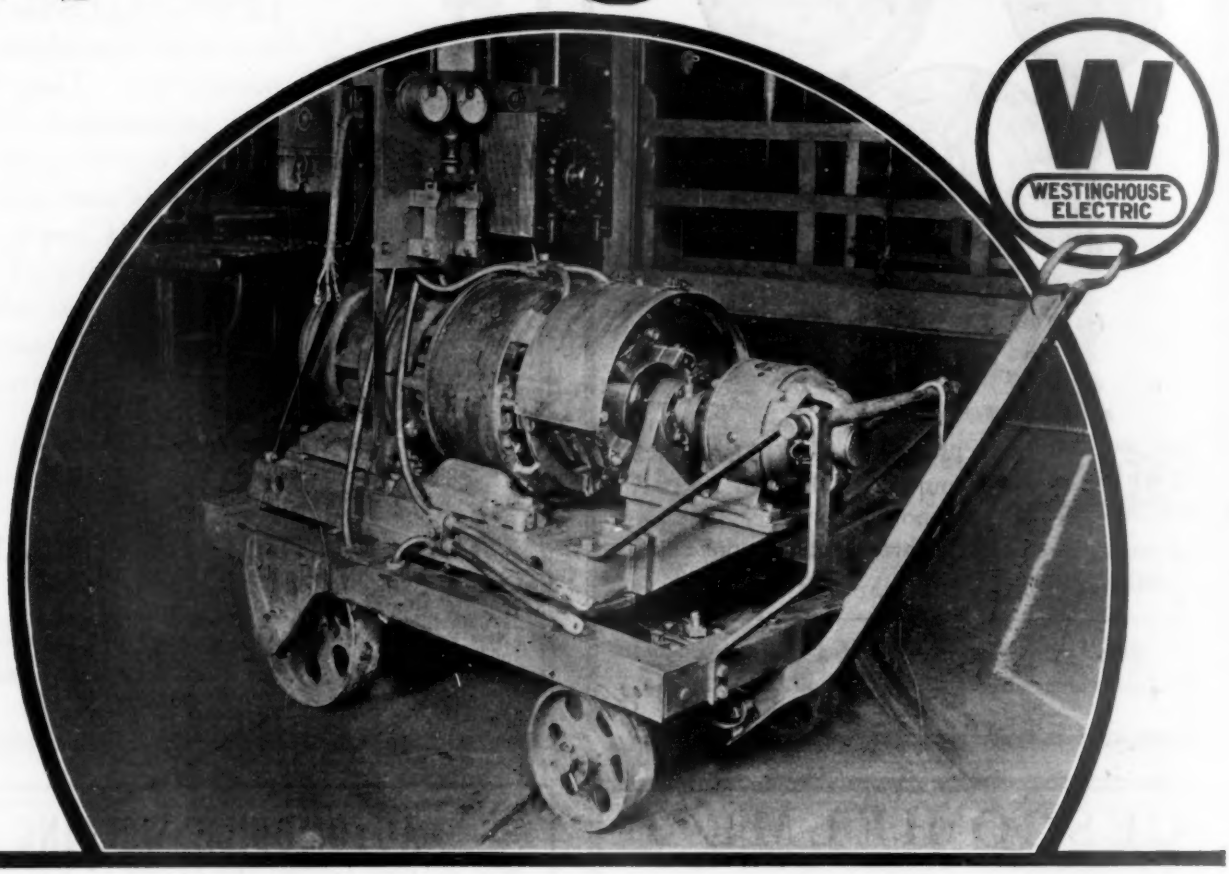

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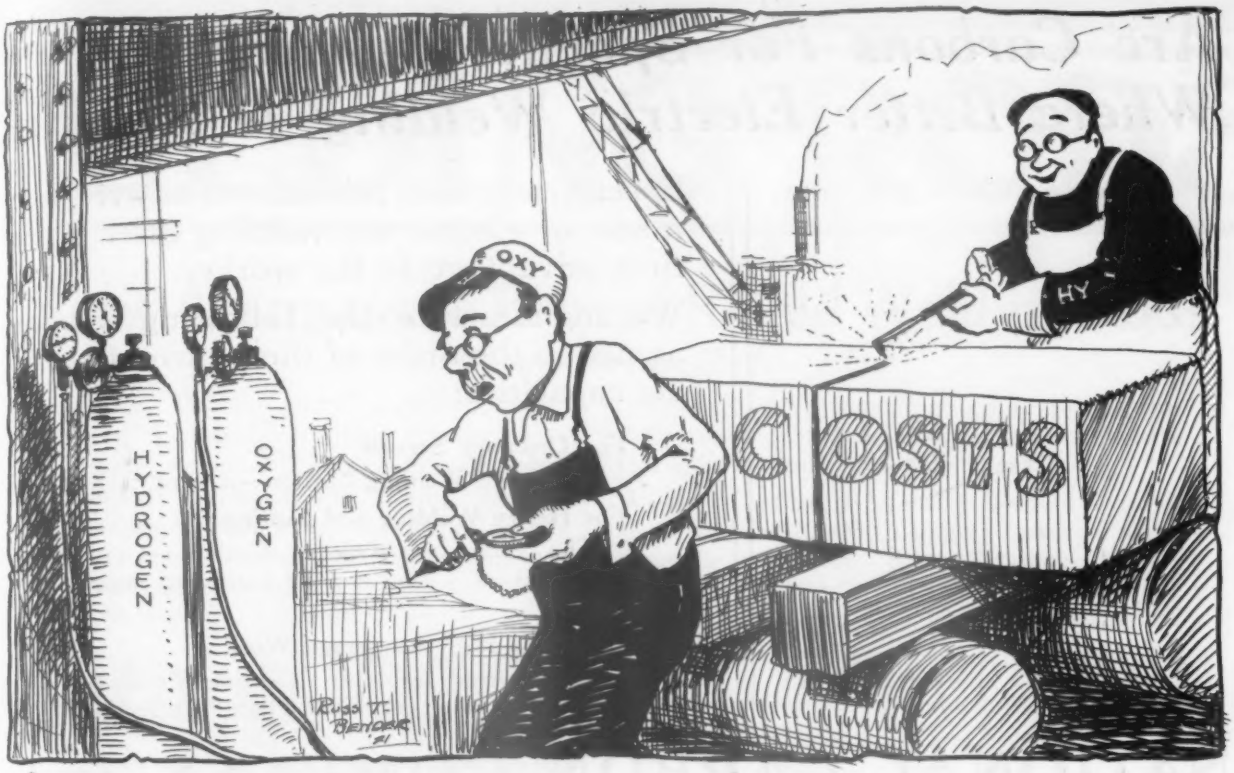

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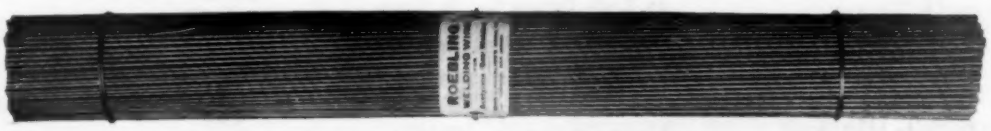

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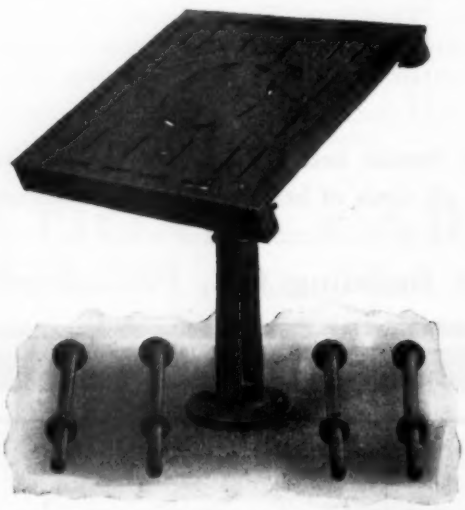

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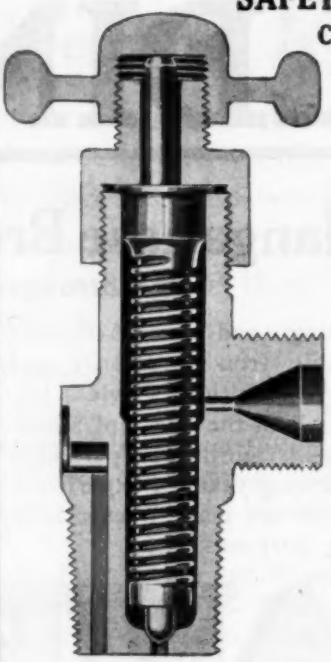

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LINCOLN ARC WELDER

Another Test Shows Lincoln Welders Best

Make of Welder	Average Welding Time Per Piece	Current Used Per Lb. of Metal Melted	Quality of Weld (Test Piece)
Welder "C"	29 min. 50 sec.	3.6 KWH	Fractures good and clean; poor penetration
Welder "B"	24 min. 20 sec.	2.4 KWH	Fractures good and clean; poor penetration
Welder "D"	19 min. 48 sec.	4.8 KWH	Fractures porous, fair; poor penetration
Welder "A"	17 min. 33 sec.	2.5 KWH	Fractures porous and dirty, poor penetration
LINCOLN	15 MIN. 4 SEC.	1.46 KWH	FRACTURES CLEAN AND GOOD; GOOD PENETRATION

The above tabulation is the result of an elaborate shop test made by a large automobile parts manufacturer to determine what welders they should buy.

It was under the supervision of their engineers and all welding work was done by one of their operators.

The work was regular production work such as is done every day in the plant. Representatives of all the firms making equipment were present for all tests except Lincoln who had men present only while the Lincoln machine was under test.

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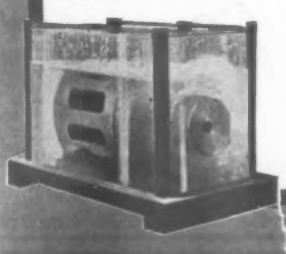

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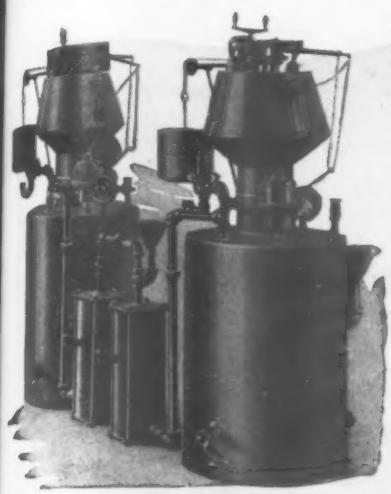

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MECHANICAL EXPANSION

By F. J. Maurer

SOME time ago in conversation with a Superintendent of a large plant that has quite an installation of Oxy-Acetylene Equipment for both Welding and Cutting, he said that he had bought several books on correct Welding Practices, had subscribed to a Welding Trade Magazine, gathered up all the information he possibly could from the various makers of Oxy-Acetylene Equipment, and found that the only thing these authorities agreed on was that Cast Iron, while the easiest metal to weld, was one that gave the greatest amount of trouble and grief, due to its being so very brittle, and while the writer believes he is right about not agreeing on all subjects that were discussed, still he *knows* they are right when they say Cast Iron welds cause the most trouble and grief, but it should not be so. In fact, it would *not* be so if the welder would only give proper thought and consideration to the job before he started welding, and less to what he should have done after the job was a failure.

Too many welders preheat a complicated casting because they think that it is necessary to do so, but never go to the trouble to educate themselves as to why it is necessary to preheat, or where it would crack if it was not preheated. They simply think if they build a fire under a casting that their chances of having a successful job is a great deal better than if they tried to weld it cold, when as an actual fact the welding of this casting might have been more successful if it wasn't preheated at all. Too much attention or thought cannot be given any casting before it is welded and by giving it this attention and thought before, will save quite a few regrets after, also will produce more successful welding jobs.

What the writer means is that when a job comes to the welding shop, or the welders go to the job, it should be absolutely decided how this job was to be done, the kind of facilities at hand for moving and turning, the amount of charcoal needed, how much Oxygen and Acetylene will be needed, the amount of Rods and Fluxes that will be used, the best location for the preheating (if necessary) how many welders he will need, and then be sure that all the men and materials are on the job before the work is started, also see that you have more materials than figured so that you are prepared for any contingency that may arise because a great many times a crack in a large casting is a great deal longer than the eye can see on first examination, due to paint, oil or grease, so having an excess of materials on hand, and it is found that there is more welding to be done than was anticipated, welding can go on without interruption. Thus, excess materials is the difference between success and failure. It also saves the Welding Shop Superintendent from getting a few more grey hairs, and above all, converts a possible loss of not only money, but prestige into a financial gain and added experience and confidence.

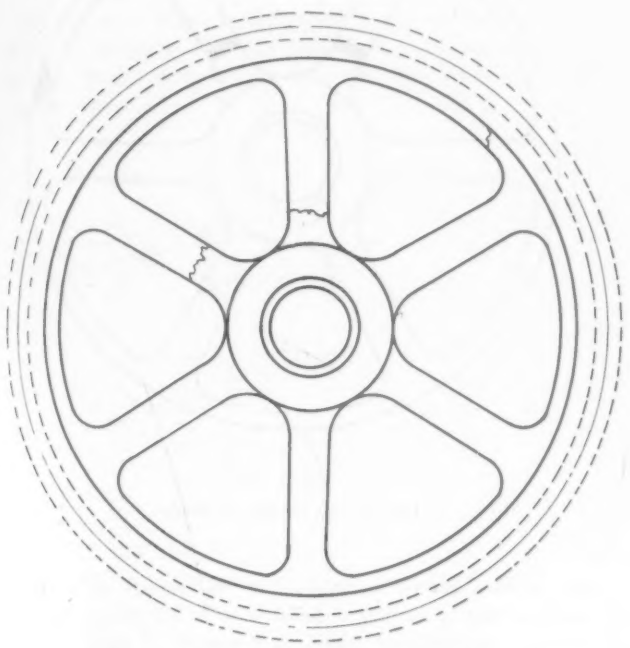


Fig. 1. Cracked Wheel Before Welding.

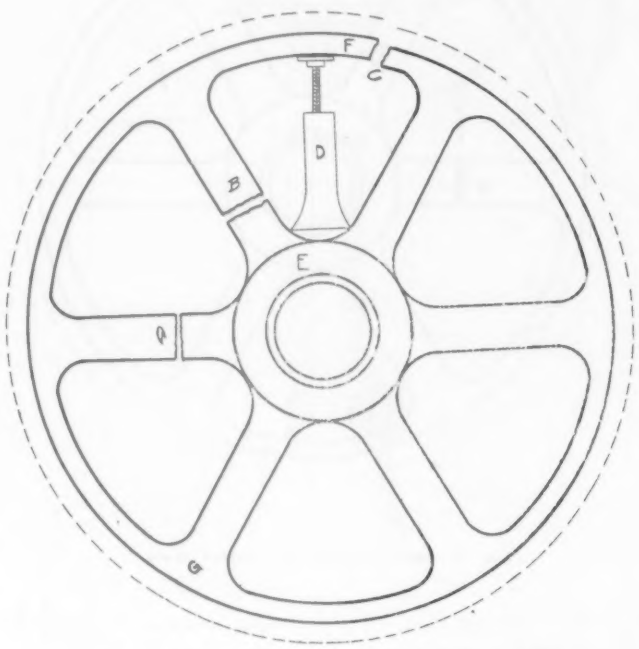


Fig. 2. Jack in Position for Making First Weld.

As an instance of what it means to definitely decide beforehand how a welding job should be done, the writer is submitting a proposition that was put to him three years ago by one of the largest manufacturing plants in the United States that was working twenty-four hours a day on War Work; They had a large Spur Gear that had broken at night, and in telephone conversation informed us to come to their plant immediately and get this Gear, and that it had to be delivered back to them, welded and ready to be installed before the night shift come on. We sent for the Gear at seven o'clock in the morning and found it to be six foot in diameter with a twelve-inch face, and had three breaks in it, two spokes being fractured, and one fracture through the face or rim as per Fig. I. The weld on the face or rim was 12 inches wide by 2½ inches thick, and the welds on the spokes were 6 inches wide by 1½ inches thick.

It was figured out that preheating this casting was entirely out of the question as that would mean leaving it in a fire after welding and covering up with Asbestos and that it could not possibly be cool enough to take out doors until the next afternoon, therefore, it had to be welded cold; the expansion to be supplied by some other agent than a charcoal fire, and

allow the contraction to take care of itself, and Figure II will show how this was accomplished.

A worm screw jack (D) was placed between the hub of the gear and the face or rim (E and F) and tightened up until the opening at fracture (A) was about $\frac{3}{32}$-inch wide. That left an opening at second fracture (B) about $\frac{1}{16}$-inch wide, also opened fracture on face or rim (C) about $\frac{1}{4}$-inch wide and about the same distance high, and is all clearly shown on Figure II. This being a large Gear and a wide face or rim, there wasn't any chance of setting up any undue strain at spoke marked (G), as the distance from the face or rim fracture (F) to the first solid spoke (G) was about 8 feet, this distance giving quite a leverage to take care of the openings caused by the jack. This scheme created for us

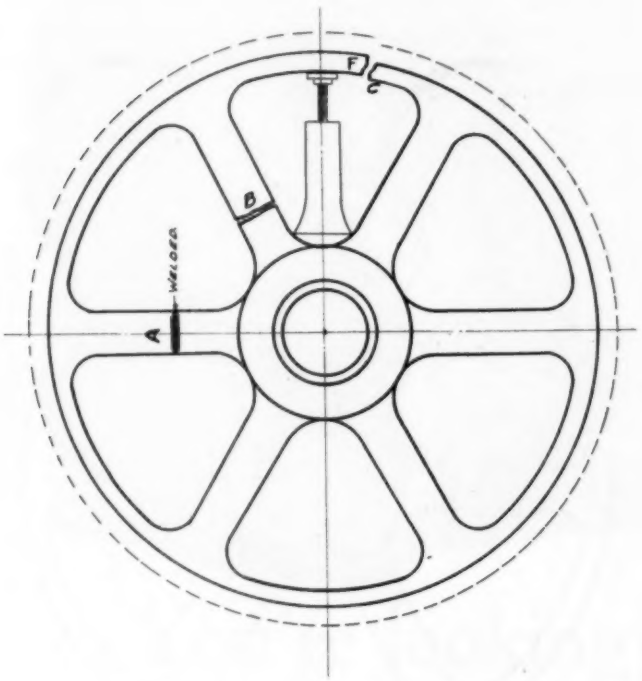


Fig. 3. Wheel Ready for Second Weld.

the same condition that we would have received if the wheel was preheated.

Instead of bevelling this fracture to a 45 degree angle with a chisel prior to welding, it was melted out with the welding torch, and while this was not the cheapest way, it surely was the quickest and most advantageous as the spoke on both sides of the fracture expanded, due to the heat of the melting out process and shortened up the $\frac{3}{32}$-inch opening to about $\frac{1}{32}$ inch, and as soon as the fracture was melted out to as near a 45 degree angle as the eye could determine, welding was started. The entire bottom of this fracture was welded, adding only enough metal to prevent the molten metal from flowing through, when the jack was loosened up to allow for contraction and weld completed.

While the weld on spoke (A) Fig. III was cooling the fracture on spoke (B) was being melted out the same as was done before, and just as soon as the opening at (B) was about $\frac{1}{16}$-inch wide, the jack was again put in place (Figure III), and welding was commenced. While progressing spoke A was kept warm by playing heat from torch on weld every few minutes to keep it partly expanded until weld at B was completed, when jack was taken away entirely and both welds allowed to cool at one and the same time. After both welds were cold we found the fracture on face F had come nicely together, so we drove a cold chisel into the fracture to spread it apart about $\frac{1}{32}$ inch. when both sides of fracture were melted to a 45 degree angle and welding started.

As soon as the fracture was tacked on the furthest side from the chisel, it was taken out and weld completed as per Figure IV.

Those familiar with these problems can see that in addition to eliminating all stresses and strains due to improper cooling, we find that every one of these welds were left in a compressing condition instead of one under tension.

Another vital essential that should be studied and figured by the newcomer and also the old timer in our line of business is the amount of heat a casting should be subjected to before it is expanded enough and ready for welding.

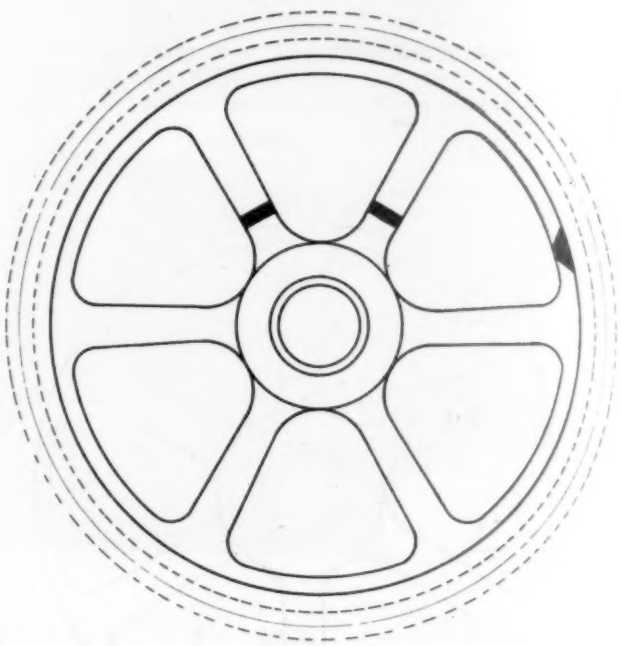


Fig. 4. All Breaks Welded.

The opinion seems to prevail in the minds of a majority of welders that a casting should be at least cherry red before it is ready for welding, when as a matter of fact, experience has taught us that this is not necessary at all, as a cherry red heat means about 1500 degrees F., and that is very near the melting point of Cast Iron, and in a majority of casting this excessive heat invariably so warps a casting that it cannot be put back in service again regardless of how good a weld was made, or that it didn't crack in cooling.

The idea that a casting that is to be welded, providing preheating is necessary, must be expanded to the limit prior to welding has been exploded long ago, and in a modern shop it will be found that castings are seldom heated to more than 1000 degrees at most.

Of course, there are exceptions to this rule, as some castings are of irregular shapes and thicknesses, when it is sometimes necessary to heat the lighter sections to a cherry red, and the heavier sections to about 1000 degrees F., this is done so that in cooling no strains are left in casting, as the lighter sections cool a great deal faster than the heavier sections, so when the piece is welded both cool about the same time.

Mr. John I. Kinsey, formerly of the Kinsey-Davidson Electric Welding Company, 208 Mayer Bldg., Milwaukee, Wis., has sold his interest to Mr. W. B. Davidson, so the name of the company has been changed to Davidson Electric Welding Co.

RETIPPING FLUES

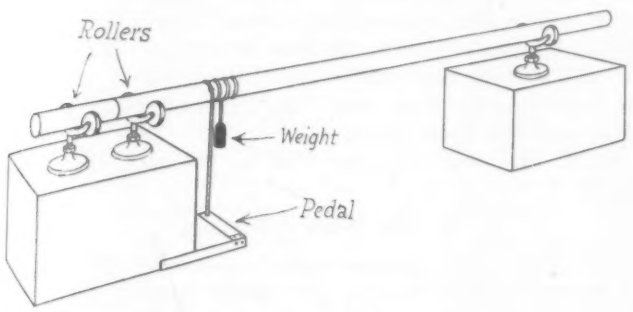
Chicago,
Sunday.

Dear Ed:—

It sure was a grand old party we staged last evening, Ed, and naturally "yours truly" don't feel like the freshest thing in seven counties this A. M. Be that as it may, I promised to answer your letter this week and now that I've started I'm going to see it through whether it kills me or not.

I suppose you are wondering what I'm doing in here when I told you I'd be in Omaha. Well, it's this way, Ed, I guess the boss thought I was selling too much stuff so he called me in to let the factory get caught up. I don't know just what he has up his sleeve, but from what one of the boys in the office dropped, I wouldn't be one bit surprised to be shot out to the coast on some private stuff until the factory has a chance to catch up. I thought perhaps I'd have time to drop down and extend greetings, but I won't know what's what until tomorrow.

I didn't know what in the world I was going to chronicle relating to welding for you this time until someone in the party last night perpetrated that old one which runs something like this:



Set-Up for Retipping Flues.

A flea and fly in a flue,
Were imprisoned so what could they do?
Said the flea, "Let us fly."
Said the fly, "Let us flee."
So they flew through the flaw in the flue.

Right then and there I remembered that I had made a few notes in a clever shop I was in last week where they were retipping flues for boilers. I had forgotten all about it, but the refrain did the trick.

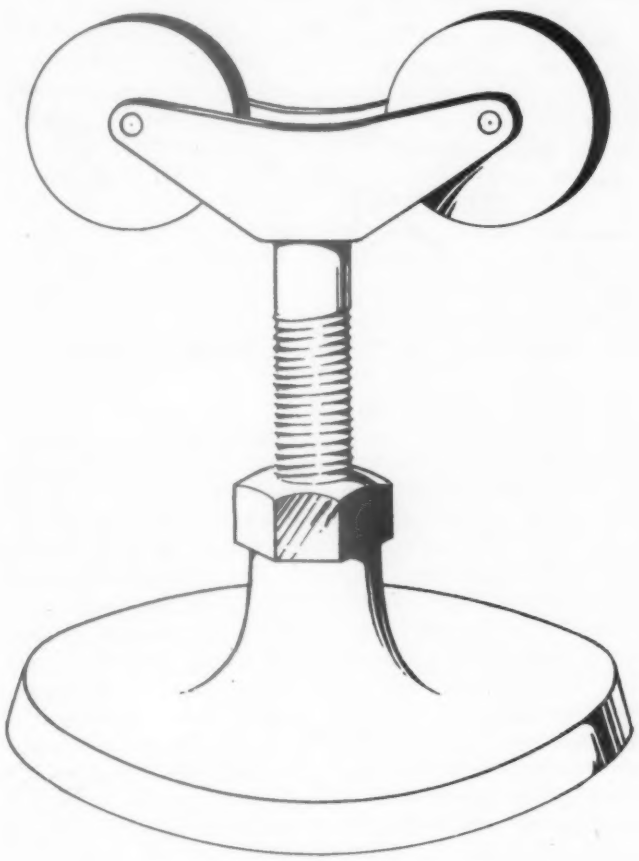
It seems that in this particular shop at certain seasons of the year they have an awful run of flue work. A poor grade of water is responsible for most of the ends being eaten away, necessitating either the replacement of all new flues or retipping. By retipping considerable money is saved the owners so they naturally favor that method. Now, I know that you have had occasion to do a little of this work, Ed, but believe me and forgive me for my plain speaking, you never turned them out as neat and as quick as this shop did so I figured you'd be sort of anxious to hear about it.

Of course, you know how the old ends of the flue are removed with a pair of cutters and then reamed out so that it won't be any smaller on the inside at the weld and can be easily cleaned out when required so I won't go into that part. When the flues are all prepared, then the new ends, measuring from twelve to twenty-four inches long, are cut off.

I asked the fellow taking me through to give me all the dope so he took me over to one corner and showed me a boy doing nothing but setting a flue and a new end in an angle iron trough in order to get alignment and "tacking" then in two places with his torch.

"You see this boy can't go wrong," my guide informed me, "the pieces if they get in that angle iron at all, have to line up and it don't require any skill in the way of welding to get them 'tacked' sufficient to have them hold until they are ready for the next operation."

"Over there," he continued, "is the pride of the whole shop. These rollers were turned out by one of our own men and while they may not impress you very strongly, yet we would find it awfully hard to get along without them. They are one of those articles that make you wonder now that you have them, how you ever ran your shop without them. Here



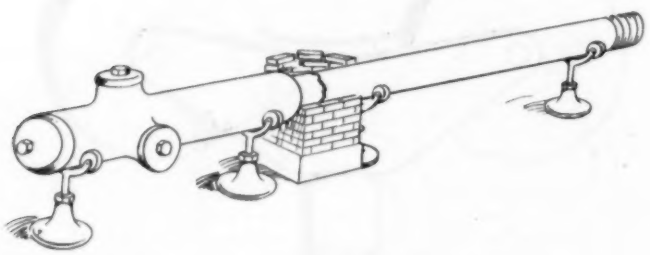
Adjustable Roller.

on this side you can see one application. When those flues are all "tacked" they are brought over here and one man does all the welding. You see the way he's jigged up here. All he has to do is lay the flue on his set of three rollers, give the weight on the end of his rope a little swing and it wraps itself around the flue. As he starts his weld he presses down on the pedal and his flue revolves just as fast as he wishes with the result that he does two men's work at once. Before we hit on this, we always had one man turning while the other welded, but you can see how it's working out now."

See is believing, Ed, and I certainly saw. I asked him if there would be any objection to me making a bit of a sketch to send you and he said, "Not the least in the world," so you'll find enclosed the results of my humble efforts as an artist. I thought while I was at it that I might just as well give you a "close-up" on the adjustable roller, so look for it, too.

"Where else do you use these rollers of yours?" I asked. "I presume they come in pretty handy on crank shafts, axels, big pipes and things like that."

"You have the idea, all right," he answered, "but you have passed up one of the biggest features. You see we have made them adjustable so that the roller proper can be raised or lowered by simply manipulating this one nut. When you run up against a shaft for example that has a number of different diameters the old style 'V' blocks are useless. With our adjustment, however, we can line them up in a jiffy. That is really how we happened to get hep to the idea. We have been doing all the work for the city water works for a good many years and it was a crime the time it took our welders to turn out a hydrant. It would actually take as much as three hours some times to finish one up and then they were always a little out. Since getting these rollers, the hydrants are laid down horizontally on them; the broken section is preheated a little and one man can finish the weld in twenty minutes. Some difference is it not? Furthermore, they are always perfectly straight. Do you blame us for boasting a bit about our adjustable rollers?"



Rollers Set to Take Shoulders of Different Diameters.

Naturally I agreed with him, but after sticking around a while and watching them put through a hydrant in another part of the shop, I couldn't help but enthuse. I wish that you could have seen it, Ed. Really an eye-opener to me. They laid the hydrant on the set of rollers arranged to receive it, but found one end to be a little low, so all they did was screw up on the roller at that end. Then the welder "tacked" it and gave it a spin; evidently he was satisfied for he put a few fire bricks around his break; threw in a handful of charcoal and turned his preheating torch on for a couple of minutes. The ends were barely red when he turned off the preheater and jumped in with his welding torch. The edges of the break were jammed together when they were "tacked" and were not beveled or prepared in any way. I noticed that he usd a pretty good-sized tip and din't have any trouble in going through the hydrant wall, which apparently measured around five-eighths or three-quarters of an inch in thickness. The weld was started on top and as fast as he would get two or three inches welded he would give the hydrant a little turn and it would respond just like it was set up on roller bearings. I timed him and he finished his weld well within the scheduled twenty minutes and it all went along so smoothly that I was "sold" that's all.

Ye Gods! I didn't know it was so late. It's me for the downy couch. More next time.

Your old pal,

Shep.

BUTT WELDING I-BEAMS

There are two methods which can be used in butt welding steel I-beams, without danger of undesirable distortions and cracks. One is to weld the middle section first and then weld the flanged sections, taking care to previously heat the part of the middle section nearest to the flange being welded. The other method is to start at the top and weld continuously through to the bottom. If the outside portions are welded first, leaving the weld on the middle section to the last, there is no way to avoid cracking when the weld cools.

FABLES FOR WELDERS

1. Fable of the Sick Horse

Once upon a time two tillers of the soil met at a cross-roads. Their conversation was as follows:

"Mornin', Cy."

"Mornin', Zeke."

"What did you give your horse when he was sick last winter, Cy?"

"Turpentine."

"Mornin', Cy."

"Mornin', Zeke."

A week later the same two met at the same place and the following conversation ensued:

"Mornin', Cy."

"Mornin', Zeke."

"Turpentine killed my horse, Cy."

"Killed mine too, Zeke."

"Mornin', Cy."

"Mornin', Zeke."

Likewise there was once a welder who boasted to a cub salesman of an astonishingly heavy weld he had completed in record time. But the salesman was not convinced that he was talking to the world's champion welder.

"It was mighty reckless to attempt such a job as that alone," he said. "You might have killed yourself doing it."

"Well, I pretty near did," admitted the welder. "My health has been so poor ever since that I've had to give up the work, and now I am selling out."

Moral: When he tells you what he has done, get *all* the details.

2. The Yokel at Niagara.

Once upon a time a country yokel stood before the wonderful waterfall called Niagara. His guide pointed out to him the beauty and majesty of the scene and told him impressively how many millions of gallons of water flowed over that dizzy height in a week. The yokel's comment was:

"Well, why wouldn't it?"

Likewise there was once a foreman who had never seen a locomotive cylinder welded in place, but was prevailed upon by a welder to let the process have a trial. A whole night was required for the preheating, and all of the following day for the welding. It was a difficult vertical weld, performed in the early days when vertical welding was not understood so well as it is today. The lone welder worked faithfully and tirelessly, without stop and without relief, and he did the job. Pridefully he pointed to the finished job and said, "That will hold, now." The foreman's comment was:

"Well, why wouldn't it?"

Moral: He who won't appreciate, won't. But we'll keep on welding, just the same.

3. The Wounded Tommy

Once upon a time there was a great war, and in that war a British soldier was wounded grievously. His story of the affair was as follows:

"We was going up and we meets a sergeant and 'e says, 'If ye stan' 'ere ye'll be blowed to 'ell.' An' we stood there an' we was blowed to 'ell, and' so was 'e, the bloomin' pessimist."

Likewise there are some in industry who can think only of the possibilities of dire calamity. When calamities come the optimistic brothers-in-industry will still have a chuckle coming at the fate of the joy-killing prophet, for nobody loves a pessimist.

Moral: He who wants to keep his friends, keeps cheerful.

BUSINESS METHODS *for* WELDERS

By Robt. B. Dyar

NO big business was ever built up on slipshod methods or guesswork. No concern ever prospered for any great length of time without giving value received for every dollar. This country is at present flooded with welding shops, both large and small, and the large majority of them are suffering during the present business conditions because there is not enough work to keep all of them busy. Five years from now will see a big change, some of the small shops of today will be big and prosperous, and some of the big ones will be even bigger, some of the small ones of today will still be small, and some of the larger ones will have slipped back, to be classed as "one horse" shops, while many of the present-day job welding shops will in five years have passed out altogether, and their owners will be working for some one else, whom they will probably refer to as "more lucky."

The purpose of this article is to outline one of the main reasons why some welding shops grow big and prosper and why some dwindle down and eventually pass out. This reason can be summed up in the three words, "proper business methods;" those that have them prosper, those that lack them fail.

How Profits Are Made

The basis of all business is to buy a thing at a certain figure and sell it again at a higher figure—thus, making a profit. Between this buying and selling various things must be done to increase the value of the thing first bought. Perhaps you buy labor and with it make changes on other materials you have bought, which increase their value so that you can sell them for a higher price than you paid for them; or perhaps you buy an article in large quantities and by your own efforts or the efforts of those you employ, you find a market for this same article where it can be sold in smaller quantities at a higher price; or perhaps you buy a number of different materials and by the use of labor and machinery, combine them into various articles, entirely different yet more useful which you can sell at a profit; or perhaps you buy a certain kind of skilled labor and by supplying this skilled labor with proper tools and giving it proper supervision, it can perform certain operations which increase the value of various articles or materials. There are, of course, many and varied applications of this principle and some of them may seem rather far fetched, but, as a general rule it holds good.

Now let us see how this principle applies to a job welding shop. In the first place you must buy something. Alright. The ordinary job shop buys three things: first a certain kind of highly skilled labor; second, two gases, oxygen and acetylene; third various welding materials or rods. The man who buys or has, these three things, can, by proper supervision and direction, form them into a service. This service can then be sold to another man who has a broken article or some pieces of iron or steel to be cut up. This service of welding or cutting will increase the value of the articles or pieces of iron or steel. Because of this increase in value he is willing to pay you a higher price for this labor, gas and welding material than you yourself paid for it and thus you make a profit.

What the Customer Buys

You buy labor, gases and welding materials and by proper supervision and direction, form them into a service which is what you have to sell.

When a man brings a job to your shop to be welded he really offers to pay a sum for the use of your skilled labor, gases and welding materials, which is higher than your paid for them. The difference between what you paid for this service and what he pays you for it is known as "gross profit." Just how much this "gross profit" should be is a very important item, because there are so many items of general expense which must be paid out of it. To express these many items in a few words they come under two headings "overhead expenses" and "net profit." It is very plain to see that if your "gross profit" is not large enough to cover your "overhead expenses" that nothing is left for "net profit" and as this is the actual and only profit that the owner of the shop makes for himself, it is a very important item.

Net Cost

However, before profits can be figured either "gross" or "net," there is one thing that must be known, and that is the "net cost" of the job that you have done, that is, the actual amount of money that you paid out for labor, gases and materials to do the job. In order to know the "net cost" of a welding job you must keep an accurate record of the labor, gases and materials you have used on that job. You would not attempt to sell anything else unless you knew how much it cost you, you would not put a price on an automobile unless you knew how much you paid for it, so why put a price on a job you have welded or intend to weld unless you know just how much it is going to cost you to do the work? Of course after years of experience a man can make a fairly accurate guess on small work, but even the best are often fooled by some of the bigger jobs, and it is in the big jobs that most of the profits are made and also that most of the big losses have to be met.

Gross Profit

If you will prosper, you must know the "net cost" of the jobs you weld, then to this "net cost" all you need to do is to add your "gross profit" and the deal is closed. Yes, it sounds very simple, but—it is in that little item of how much "gross profit" to add that most of the trouble comes. If you add too much you have a dissatisfied customer, which is worse than having no customer at all. If you do not add enough gross profit you will not have enough to pay for your overhead expenses and your own profit, and your business will go on the rocks.

Overhead

Of the two items which go to make up "gross cost" namely "overhead" and "net profit" it is the item called "overhead" that gives most welding shops trouble, yet it is a *most* important factor, so let us take this item of "overhead expense" and see just where we stand on that. We first stated that you buy skilled labor, certain gases and welding materials, which by proper direction and supervision you form into a service which is what you have to sell. It is during the forming of the three things you buy into the service which you have actually sold that you incur this item of "overhead expense" which is really composed of a large number of smaller items. To illustrate further. In order for your skilled labor to make use of the various gases and welding materials which you have bought you must comply with certain conditions. You must rent a shop which you must heat in the winter time. You must furnish light to work by and power for your labor to use. You must carry insurance and pay taxes on your property. You must employ certain non-productive help to keep your books and assist in the general work of running your business. You must pay for advertising and selling your product. You must pay interest on any money you borrow and replace articles used in your shop which break or wear out. You must buy various items for your men such as goggles, gloves, flux chalk, oil, charcoal, tools, etc. In other words you must pay out money for various things needed to properly conduct your business

and this money or the cost of running your business is what is known as "overhead expense."

The next question is "just how is this 'overhead expense' added to the 'net cost' of each individual job that goes through your shop?"

Figuring Overhead

In order to do this it is necessary to keep an accurate record of the money spent for overhead items. When this is done, it will be found that the amount of money paid out for these items for a specified length of time, bears a certain relation to the amount of money you have paid out for skilled labor, gases and welding materials for this same particular period. Suppose for example that for the first six months of this year you paid out in wages to your welders, and paid out for oxygen, acetylene and welding rods the sum of $1,000.00. For the same six months you paid out for overhead items the sum of $500.00. The $1,000.00 is the total "net cost" and the $500.00 is the total "overhead expense." It is plainly seen from this that the "overhead expense" for this period was just half as much as the net cost in other words the overhead was 50 per cent of the net cost. This 50 per cent is what is known as the "percentage of overhead."

As it is almost impossible to figure out in advance what your "overhead expenses" will be, the generally accepted method is to take the figures for the past six months to work out your "percentage of overhead" and use this percentage for the next six months which follow. For example, you have found that your "percentage of overhead" for the first six months was 50 per cent.

Fixing the Price to the Customer

If you have done a job on which the "net cost" figures up to a total of $5.00, (that is you have spent $5.00 for labor, gases and materials on the job), you then know from your figures on your first six months' business that it cost you 50 per cent of your "net cost" to take care of your overhead expense needed to run your business. Then in order to take care of the portion of the overhead expenses which this particular job must pay, you merely add 50 per cent to the net cost of the job, which makes $2.50 added to $5.00, giving a total of $7.50 which is known as the "gross cost" of that particular job as it includes the "net cost" plus "overhead expense;" however, this figure does not include any profit for you, so to this "gross cost" you must now add your "percentage of profit." In many lines of business this is a certain fixed percentage, so let us assume that you feel the job should pay you 50 per cent, then to the "gross cost" or $7.50 you add 50 per cent or $3.75 making a total cost to the customer of $11.25.

The $11.25 paid you by the customer then divides up as follows. Net cost to you for welding the job $5.00. Overhead expenses $2.50. Net profit $3.25. By figuring your charges in this manner you are using proper business methods and are sure of a profit on every job that goes through your shop.

Play Fairly with the Customer

By using these methods you also gain the confidence of your customer which is the biggest asset a welding shop can have. If your customer feels that he is paying you a fair price for the work you do he will not only bring all of his work to your shop but will tell his friends about you.

The idea of charging a customer "all that the traffic will bear" is wrong, dead wrong. It is not justice to your customer and will sooner or later mean the ruin of the welding shop that does it.

The old method of using guess work in fixing a charge for a job that has been welded is wrong, and no welding shop will grow into a big money making business that uses this slipshod method.

Competition Makes System Necessary

In the old days when welding shops were few and far between, when cutting cast iron was a stock joke to pull on an apparatus salesman and a "non flash back" torch had never been heard of, a man could charge just about what he wanted to, for a job that had been welded, but nowadays with competition keen and work scarce it is the shop that plays fair with its customers and by using proper business methods, regulates its charges so that its customers get their money's worth that will survive and prosper. "Success" is not made in a day. "Good will" is not built up overnight. It takes time to get the confidence of a community, but any amount of time or energy is wasted unless backed up by proper business methods.

CANADIAN PLANTS USE THERMIT PIPE WELDING ON LARGE SCALE TO PREVENT AMMONIA LEAKAGE

The great advantages of permanence, lower cost, and ammonia saving, gained by eliminating joints in ammonia pipe coils by thermit welding as compared with installing ammonia flanged connections are being appreciated on a large scale by the Linde Canadian Refrigeration Company, Ltd., Montreal, Que., which handles refrigeration machinery for industrial plants and ships.

Since adopting the thermit pipe welding process in 1918, this company has ordered material for welding in the neighborhood of fifteen miles of 1¼ in. extra heavy steel and wrought iron pipe for refrigeration units installed in a large number of industrial plants. The length of coil used varies from 500 to 5,000 feet. The whole coil area is made up in sections of endless pipe. These sections are flanged and bolted together on the job. The sizes of the sections vary from 6 feet to 36 feet in length and from 3 pipes high to 20 pipes high. There is one weld for every 20 feet of pipe used. No screwed fittings are used on any of these installations, but instead the pipe is bent to suit and male and female flanges are connected together using a lead gasket. The coils are flanged before being shipped and tested to at least 150 pounds hydrostatic pressure test. In very few cases has it been found necessary to cut out a weld.

Linde refrigeration apparatus has also been installed on S. S. "Canadian Fisher" and S. S. "Canadian Forrester" of the Canadian Merchant Marine. The coils thereof are continuous, having been made so by using thermit as a butt welding agent.

U. S. GUNBOAT "YANTIC" BOILERS ARC WELDED

An incident in connection with the Pageant of Progress, which occurred right off the pier proved that electric arc welding ceases to be an experiment and that it will soon be the Big Gun in manufacturing as well as repairing. The U. S. gunboat "Yantic" from Detroit, one of the three gunboats which have been maneuvering in the vicinity of the Municipal Pier during the Pageant, was laid up with several cracks in the main boiler.

The gunboat was scheduled to leave Chicago on Wednesday morning, August 10th, but a leaky main boiler was discovered on Tuesday, the 9th. The Mitchell Co. of this city, who were called in to do the job of welding the two-foot cracks at the rivets on each side of the Adamson ring, completed the welding by 2:00 a. m. Wednesday. After test, which proved satisfactory, the gunboat was ready to leave on schedule.

During the war the captured German ships which were damaged were repaired by the same process as this in the New York Harbor.

The Air Reduction Co., 120 Broadway, New York, is having plans prepared by Francisco & Jacobus, 511 Fifth Avenue, architects, for its new plant on property recently acquired on Ridge Avenue, Pittsburgh, for the manufacture of commercial oxygen.

CUTTING TORCH SCRAPS OUR SCRAPPING TOOLS

These illustrations show what often happens when "Finis" is written to the service of Uncle Sam's fighting tools. Six twelve-inch mortar carriages, part of the fortifications protecting Long Island Sound, are being removed from their positions of dignity at Fort Wright, Fishers Island, to the less glorious confines of a scrap yard at New London, Conn.

"Finis" was written officially to their service last spring, when the carriages were sold by the government as scrap. The guns originally mounted on the carriages were remodeled for use with mobile artillery during the war.

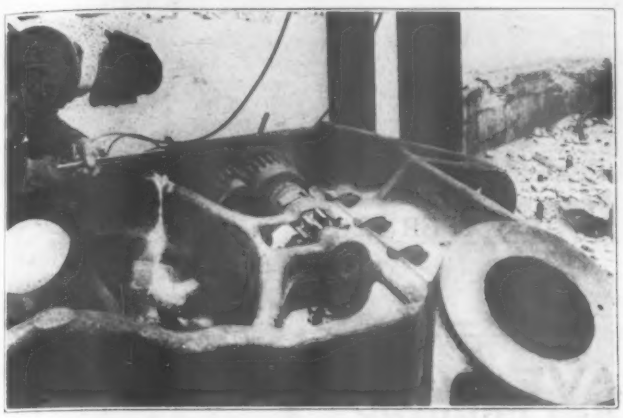


Fig. 1. Cutting up a Section of a 12-Inch Mortar Carriage.

The task of removing the scrap material is no easy one. Many of the sections are heavy and cumbersome. The purchaser has attempted to reduce the castings to portable size by blasting with dynamite. Blasting, however, has not proved satisfactory, owing to the labor and time involved in moving the unwieldy metal from the concrete battery positions to open fields nearby, the danger of flying fragments hitting passing soldiers and the inability of the charge to fracture the steel sections easily.

Fig. 2. This Heavy Casting was Cut in Less than Fifteen Minutes.

The difficulties experienced with dynamite led the purchaser to investigate the possibilities of the oxy-acetylene flame in cutting metals, especially cast iron.

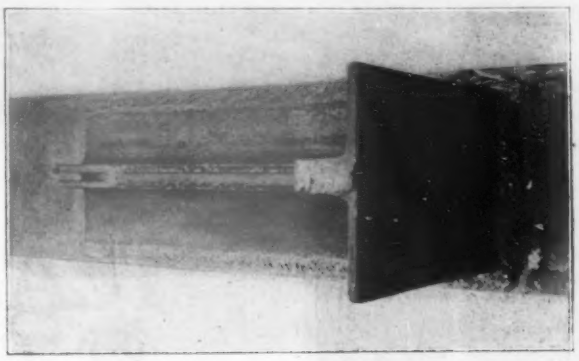
Demonstrations were made by an expert cutter of the Air Reduction Sales Co. Engineering Service Deparment. These were so successful that it is expected the use of dynamite will be discontinued, and the oxy-acetylene torch utilized to cut up the balance of the metal.

It took several days to move the base ring of the twelve-inch mortar carriage shown in Figure 2 to a point outside its battery position, where it could be dynamited in safety. As an example of the value of the of the oxy-acetylene torch for cutting up scrap material, the operator shown in the picture made a cut through the cast iron section in less than fifteen minutes. This cutting operation could have been performed inside the battery emplacement as easily as outside, so that the heavy casting could have been reduced to sections of portable size without going to the trouble of moving it to a considerable distance beyond the emplacement.

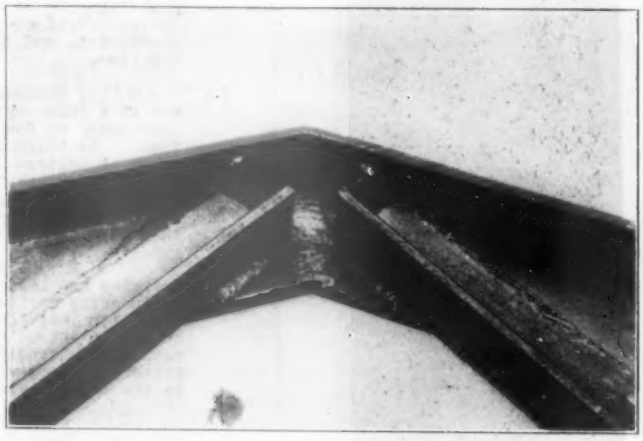
ARC WELDING SUPPLANTS RIVETS FOR STRUCTURAL WORK

That arc welding is continually finding new and important industrial applications is being demonstrated by numerous reports of successful welding. In a recent publication issued by the Westinghouse Electric & Manufacturing Company, entitled "Arc Welding Applications," many interesting and novel uses of arc welding are explained and illustrated.

One of the applications shown is a structural steel building erected without the use of rivets. The electric arc was employed throughout the entire construction to unite the structural steel members. Inasmuch as the entire construction was tested and approved by the New York Bureau of Buildings, the arc welding process for this line of work has passed from the experimental stage to the practical commercial stage. The trusses are designed for a live weight of 40 pounds per square foot, each truss supporting a panel of 800 square feet. They were tested at a load of 120 pounds to the square foot,



Welding a Heavy Section.



The Advantages of Welding are Readily Seen Here.

or a total load of 48 tons on the two trusses.

The main advantages of arc welding, for this work, are the elimination of the necessity for fabricating the steel parts and the saving of time in waiting for the girders to be fabricated. Another decided advantage of the arc welding method over that of riveting is that it does away with the noise of riveting and makes it possible to work day and night without causing any disturbance.

This unique example of the use of arc welding has aroused a great deal of interest in the building trades and industrial plants. Although no extended use of this principle has been made as yet, it is quite possible that great development may be made in the near future.

WELDING AND CUTTING APPARATUS

MEN OF EXPERIENCE

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SPRINGFIELD, MASS.

August
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1921

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Because of our experience and standing in the industry, we do not as a rule write recommendations of any equipment. However, in your case, we feel that we are not detracting from our prestige in so doing. We think that we have the right to be proud of our standing because we believe that we were the first job welding plant established in the United States (1908), and at that time it was necessary for us to do considerable missionary work as there were very few people who realized that metal parts could be welded and made as strong, if not stronger than they were originally.

Mr. Cave our President, undoubtedly did more pioneer work thru articles and lectures which he gave before a large number of the leading Engineering societies in this county to promote the welding industry, than any other individual. At the present time, Mr. Cave holds patents on a number of inventions which are closely related to the welding industry, he having done considerable amount of research work along these lines. The writer has supervised the welding of some of the largest jobs carried out by the oxy-acetylene process in this country.

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PENNSYLVANIA BOARD MAKES NEW BOILER CODE RULINGS

Rulings pertaining to steam boilers adopted on May 24, 1921, by the Industrial Board, Department of Labor and Industry, Commonwealth of Pennsylvania, contained the following regulations regarding the use of autogenous welding:

Autogenous Welding.

Rule 006 (A-1). By "autogenous welding" is meant any form of welding by fusion, that is, where the metal of the parts to be joined or added metal used for the purpose is melted and flowed together to form the weld. Such welding is accomplished by the oxy-acetylene, hydrogen or other flame processes, or by the electric arc; no distinction is made between any of these processes.

Autogenous welding may be used in boilers in cases where the strain is carried by other construction which conforms to the Rules formulated by the Industrial Board, Commonwealth of Pennsylvania, and where the safety of the structure is not dependent upon the strength of the weld.

The following paragraphs will serve to point out where such work will be accepted or rejected:

A Group of Cast Iron Boiler Sections Welded and Ready for Welding.

1. Any autogenous weld of reasonable length will be permitted in a staybolted surface or one adequately stayed by other means so that, should the weld fail, the parts would be held together by the stays. It is necessary for the approved boiler inspector to use judgment in interpreting the meaning of reasonable length as given above, since it may vary in different cases. In the average case it should not be more than 3 feet. Autogenous welding will not be accepted in unsupported surfaces. Where the heads and furnace sheets of steam boilers are welded by the autogenous process the weld shall be not less than 12 inches below the water line. Autogenous welded construction will be accepted in lieu of riveted joints in the fireboxes of internally fired boilers, provided the welds are between two rows of staybolts.

2. The edges of the inner and outer sheets of vertical firebox boilers, or boilers of the locomotive type, may be joined by autogenous welding to form the door openings, if the surrounding surfaces are thoroughly stayed. This would also apply to other openings of a similar character in such surfaces.

3. For low-pressure plate-steel boilers operated at a pressure not exceeding 15 pounds to the square inch, or for higher pressure in unfired vessels subjected to water pressure only, rectangular headers may be autogenously welded at the edges if the sheets are properly held together by stays. Autogenous welding of cracks and fractures in cast-iron boilers will not be permitted.

4. Fire cracks in girth seams extending from the edge of the plate to the rivet hole may be autogenously welded provided the cracks are properly prepared by cutting out the metal at the crack in the form of a letter "V" to permit fusion through the entire thickness of the plates. Similar cracks in girth seams located between the rivet holes may also be autogenously welded, provided the cracks do not extend beyond the edge of the lap of the inner plate. In the latter class of cracks it is advisable to drill a hole not exceeding ⅜ inch in diameter at the end of the crack before the weld is made. Cracks extending from rivet hole to rivet hole on girth seams cannot be welded. Calking edges of girth seams may be built up by autogenous welding between rivet holes and the calking edge where the original section of the metal to be built up averages the equivalent to ¼ of the diameter of the rivet hole; and the portion of calking edge to be replaced does not exceed 30 inches in length in a girthwise direction. In all repairs to girth seams by autogenous welding the rivets must be removed over the portions to be welded and for a distance of at least six inches at each end beyond such portions. After repairs are made the rivet holes should be reamed before the rivets are re-driven.

5. Stayed sheets which have corroded to a depth of not more than 40 per cent of their original thickness, may be reinforced or built up by autogenous welding. In such cases the stays shall come completely through the reinforcing metal so as to be plainly visible to the inspector.

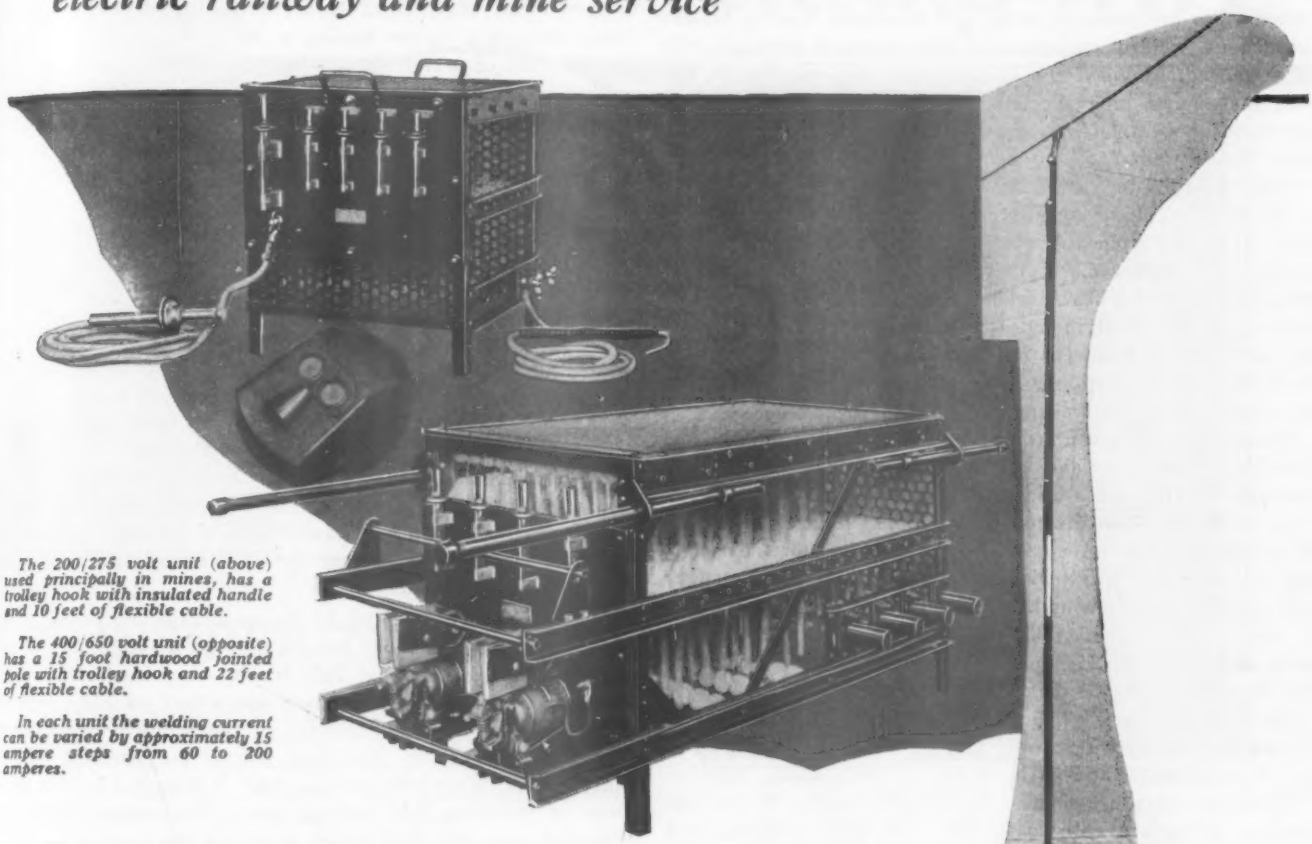
6. Where tubes enter flat surfaces and the tube sheets have been corroded or where cracks exist between the tube ligaments, autogenous welding may be used to reinforce or repair such defects. The ends of such tubes may be autogenously welded to the tube sheets. The above-mentioned repairs for tube sheets and the welding-in of the tubes in the sheets, are not to be permitted where such sheets form the shell of a drum or boiler, as in the case of the Stirling type of boiler.

7. When external corrosion has reduced the thickness of the plate around handholes to not more than 50 per cent of the original thickness and for a distance not exceeding 2 inches from the edge of the hole, the plate may be built up by autogenous welding.

8. Pipe lines will be accepted where the flanges or other connections have been welded autogenously, provided the work has been performed by a reputable manufacturer and the parts properly annealed before being placed in position. Such welding when made with the part in place and unannealed will not be acceptable.

9. Autogenous welded-in patches in the shell of a boiler will not be acceptable regardless of the size of such patches. Autogenous welding of cracks in the shell of a boiler (except those specified in paragraph 4) regardless of the direction in which they may lie will not be permitted, unless such weld-

Electric arc welding sets which can be carried by hand, and operated from a trolley wire, are advantageous in electric railway and mine service



The 200/275 volt unit (above) used principally in mines, has a trolley hook with insulated handle and 10 feet of flexible cable.

The 400/650 volt unit (opposite) has a 15 foot hardwood jointed pole with trolley hook and 22 feet of flexible cable.

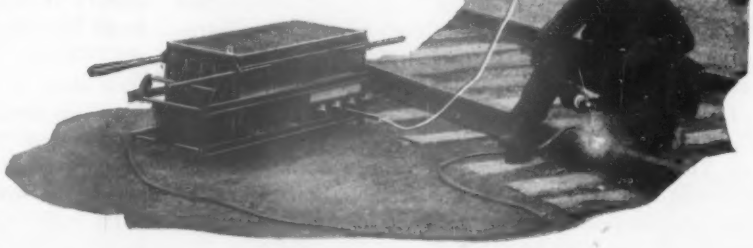
In each unit the welding current can be varied by approximately 15 ampere steps from 60 to 200 amperes.

Save time and money by using G-E Welding sets

The type AW Resistor Arc Welder is specially designed for the welding of rail bonds, fish plates, etc. In mines, electric railway fields, or in industrial plants where it can be hooked to a trolley wire, this equipment can be carried easily to the job which your welder can do in quick time at a minimum cost.

The unit is light in weight—the 200/275 volt welder, 60 lbs; the 400/650 volt welder, 140 lbs. Handles, conveniently placed, make it easy for the workmen to carry. Exposure to the weather will not injure the insulation or the resistance wire.

Strength, durability, speedy production, low cost of operation—these are some of the qualifications of the type AW Resistor Arc Welder. Ask the nearest G-E office for complete information.



Welding rail bond with 400/650 volt unit. Note foot-operated push button station for making and breaking welding circuit at a remote point, which protects operator.

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ing is only for the purpose of securing tightness and the stresses on the parts are fully cared for by properly riveted-on patches or straps placed over the weld. The plates at the ends of joints may be welded together for tightness, provided the straps or other construction are ample to care for the stresses on the parts so welded.

10. Re-ending or piecing of tubes for either firetube or watertube boilers by the autogenous process will not be permitted. For low-pressure steam and hot-water heating boilers autogenous welded construction for unstayed surfaces will be permitted, provided the thickness of the material in the shell plates and tube sheets is not less than that required for power boilers. (See paragraphs 18 and 20 of Pennsylvania Boiler Code.)

"The welding of cast iron heating boiler sections," says S. W. Miller, commenting on these regulations, "is perfectly safe, if proper preheating, welding, reheating, and cooling methods are followed. Usually the whole section must be preheated to a red heat, welded, reheated to the same temperature, and packed in loose asbestos or dry sand to cool. We have welded hundreds of them successfully. I enclose a photo showing 10 sections of various sizes in our yard at one time either welded or waiting.

"Paragraph 8. It can be shown that where ordinary pipe is welded there is no danger from strains. The ductile, low strength material takes up nearly all strain, and what is left is so small in amount as to be negligible. There is no need of annealing to remove strains, and as the fibre stress is only one-half that lengthwise of the pipe, there is no danger provided the weld is sound. I think this section is too rigid. It would seem clear that some consideration should be taken of the size of the pipe. It is much easier to weld 4 in. pipe than 24 in. pipe, and the factor of safety is much greater in the former case. I believe it would be perfectly safe to remove all restrictions on welding pipe for any purpose, up to say 10 in. diameter and ⅜ in. thick.

"I see no other criticisms. The restrictions, with the exceptions noted, are entirely in line with good practice, and with the regulations of the I. C. C., Federal Steamboat Inspection, and other authorities, as far as I can see."

ELIMINATING BLOW HOLES IN THERMIT WELDS BY THE USE OF NEW MOLDING MATERIAL AND NEW STYLE MOLD BOXES

A new grade of molding material for Thermit welding has recently been developed by the Metal & Thermit Corporation which, as proved by extensive researches and practical experiments, when used in accordance with the regular Thermit practice, will definitely prevent blow holes and assure sound welds. This new molding material has already been introduced in many of the larger railroad shops, where the beneficial results obtained therefrom have won enthusiastic approval. The new material, designated as "Thermit Molding Material" is quite different from ordinary molding material and in all Thermit work, either this, or a substitute which has been tested and approved by the Metal & Thermit Corporation should invariably be used.

The design of the new molding material is based on the theory that good silica sand will stand the heat of the Thermit reaction very well and that the weakness in all molding material is the clay binder. Therefore, there should be as little clay as possible in the mixture, in order to make the mold more refractory and to increase its porosity. It is logical therefore, that the use of a plastic clay has been selected instead of a fire clay, as formerly. The sand and plastic clay are ground together in a foundry pan or Moller, with the intention of coating each grain of sand with a minimum thickness of clay. This has resulted in a good, clean molding material which should be rammed hard in the mold, which will stand up well under the preheating flame and which is extremely porous to the gases generated in the mold, resulting in a sound weld with a very clean exterior. Although suitable molding material can be made by increasing the clay content slightly and mixing the clay and sand thoroughly by hand, it is not so good as that made with a smaller clay content in the foundry pan or Moller.

The mixture now being used is composed of the following: 3 parts clean, sharp silica sand (100 per cent of which should pass through a screen having a .03 in. square opening, and 40 per cent of which should be retained on a screen having a .012 in. square opening), mixed with 1 part Welsh Mountain plastic clay. These parts are first thoroughly mixed in the Moller together with 1/40th part glutrin by volume and sufficient water (1/12th part) to bring to the proper consistency. If mixed by hand, the sand and clay must be dried before mixing (being careful not to subject the clay to a temperature higher than 400° F.) and thoroughly mixed before adding the glutrin and water. The glutrin should be mixed with the water before adding to the sand and clay.

In case a plastic clay fatter than the Welsh Mountain be used, the mixing, of course, will have to be more thorough and less clay used. Welsh Mountain clay is being used in the present mixture because in carefully run tests it has proved to be the most refractory the use of the new molding material necessitates harder packing next to the weld; in fact the regular Thermit rammer may be supplemented by the use, for instance of a tool having an end ⅜"x1½" so that the operator may be able to peen the sand next to the wax collar and the various patterns.

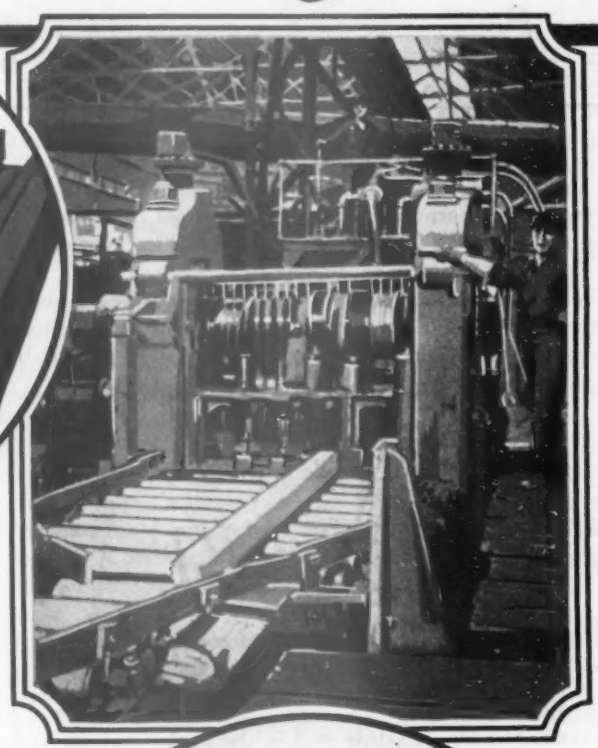
It is absolutely essential, in the production of sound welds to be sure that no loose sand exists in the mold when the Thermit steel is poured. This is why very hard ramming is advocated, also why it is most important to blow out all loose material from the interior of the mold by putting the preheating burner in the riser before the heating gate is plugged and being sure that no sand is detached by the operation of inserting this heating gate. The burner should be removed from the riser before plugging the heating gate, because otherwise it may detach some sand, which could not be blown out after the plug is in place. The heating gate plug should be thoroughly dry; and, if it has been carried in stock for some time, it should be warmed before using.

By perforating the sides and bottom of the mold box, the escape of the gases which pass through the molding material is greatly facilitated. ⅜" dia. holes, spaced 3 or 4 in. apart, are sufficient. To facilitate the escape of gas from the bottom of the mold box, the mold should rest on blocks, not directly upon the foundry floor. As unnecessary molding material simply increases the resistance to the passage of gas, the mold box should be made as small as possible commensurate with safety. For example, in welding a 4 in. x 4 in. section, only about 4 in. of sand is necessary at all points, except, perhaps, on the pouring gate side. It is most important to thoroughly vent the mold box by forcing a rod or wire down at a number of points to within ½ in. or so of the collar. Care should be taken that these do not touch the collar because such vent holes will fill with steel and will therefore not facilitate the escape of gas.

NEW BENCH TYPE SPOT WELDER IS CONVENIENT

A new bench type spot welder which occupies the almost negligible floor space of 10 by 17 in. and which has a capacity for two sheets of No. 16 gauge metal, has recently been produced by the Taylor Welder Co., Warren, Ohio. The cast copper frame of the device acts as a secondary. The horns are of cold-drawn material, the bottom one being adjustable to three different positions. The machine is foot operated.

Sound Ingots produce Sound Welding Wire



CONSIDER THE INGOT

PAGE ARMCO Welding Rods and Electrodes start from a ***sound ingot*** (99.87% pure iron) free from physical imperfections and of such chemical analysis that gases and other detrimental impurities are absent.

This combined with scientific rolling and drawing operations produce ***sound welding material*** absolutely essential to ***sound welds.***

PAGE ARMCO Welding Rods and Electrodes fulfill all requirements of the American Welding Society specifications.

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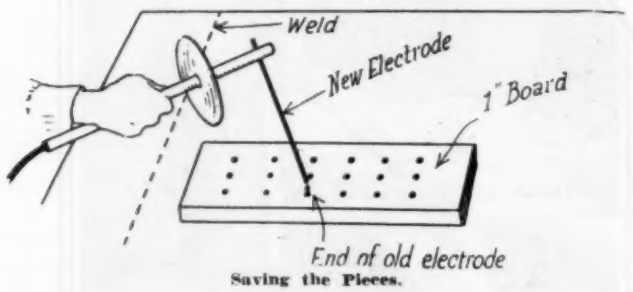
Hints for the Welder

When you finish an interesting piece of work, can you set down on paper the manner in which you went about the job, how you prepared the work and how the job was done? Have you learned some little stunt every welder ought to know? Contributions to this department are paid for. Write it down any old way – I'll polish it up. Make a rough pencil sketch and our draughtsman will fix it up fine. Line drawings are more practical than photographs. Do it today – the men on the firing line are waiting. L. B. Mackenzie, Editor.

SALVAGING ELECTRODE STUBS

Mr. Val Becker, the welder of the Locomotive Stoker Co., a Pittsburgh, Pa., corporation, has worked out an ingenious scheme for salvaging the short stubs of metallic electrode left in the holder and usually thrown away.

A 1-inch board is secured with a lot of holes drilled through; this board is laid flat on the work plate; and after using a length of electrode, the stub is stuck endwise in one of the



Saving the Pieces.

holes projecting through and touching the work plate. A new length of electrode is inserted in the holder and the stub is "picked up" by touching the stub with the new electrode.

By using this scheme every last ounce of electrode is used and the time required is negligible, provided an approved type of electrode holder is used.

USE OF RRONZE FILLING ROD

By O. T. Hart

Of all the interesting and helpful articles published in *The Welding Engineer* it seems that few writers have much to say about the bronze filler rod and its use in quick repair work. I use acetylene welding equipment in an engine house and have a good assortment of all kinds of filler rods. Of course, they are all necessary, but I value the bronze rod because it can be used for quick and usually permanent repairs, on a large part of cast iron pieces as well as on malleable iron, brass, copper and bronze castings, and could be used occasionally on steel castings or wrought iron forgings if the supply of the proper filler rod should be exhausted.

Our shop being a running repair shop, about two hundred miles from the back shop, it is necessary to get the work done as well and as quickly as possible. Therefore, I wish to mention some of the good results we have had from the use of the bronze filler.

Preheating is usually necessary when gray iron is welded with a gray iron filler rod; but preheating is seldom necessary with the bronze rod. This item alone is a great time saver on engines in service. Time is also saved through not having to anneal the casting after welding, because it has not been heated enough to destroy or disturb its properties.

About one and one-fourth pounds of bronze rod was used to repair an air brake cylinder, where if gray iron filler rod had been used the job would have required preheating and annealing. In this case the cylinder would have been scrapped and a new one put in if I had not used bronze. The job was done in about two hours and the cylinder is giving as good service as it did before it broke.

In another instance, about eighteen months ago, one and one-half pounds of bronze rod and two hours' time was all it took to braze a crack in an air pump that is running today as well as ever. This, of course, would have been quite a job to handle with a gray iron filler, besides costing about sixty dollars according to the foreman's figures.

There are a number of other jobs we have running which were done with the bronze rod, and which we are always glad to show. Only a few precautions are necessary to accomplish good and quick work on an average job. It is necessary to prepare the job as usual, getting it clean of grease and oil. After it is prepared, do not touch the brightened surfaces to be brazed with oily or greasy hands or gloves. Do not use a dirty, oily, or cracked bronze. Brighten it with emery cloth before using. Heat the line of weld to a cherry red (the exact heat can best be determined by practice). Do not play the flame on the bronze too long or the result will be copper slag instead of bronze. Properly melted bronze can be recognized by its color after cooling, which is the same as the color of the rod before melting.

MIX THERMIT THOROUGHLY BEFORE USING

Occasionally Thermit welders find that they are unable to produce the requisite amount of steel from the Thermit which they are using. This is entirely due to the fact that the ingredients (iron oxide and aluminum) have become unmixed. The importance of mixing Thermit thoroughly before using cannot be too strongly emphasized, whether a whole bag or part of a bag is to be used. It is logical that, as the iron oxide is in the form of a flake and the aluminum is in the form of a little round ball, also that as they are so different in specific gravity, they will segregate in the vibration caused by transit. The bag, therefore, should be dumped and the material thoroughly mixed by hand before putting it into the crucible. In a recent case, the Metal & Thermit Corporation investigated the variations in the speed with which Thermit reactions took place; this variation was found to be entirely due to segregation of materials and was entirely eliminated by re-mixing.

OXYGEN TANKS MOVED ABOUT EASILY WITH HANDY TOOLS

Made of a light iron rod or pipe about four feet in length, having a ring bent on one end large enough to fit over the valve cap, and a hook in an "L" shape on the other to drag them around with.

It will be found easy to make and use. In plants or shops where there is a narrow-gage railway it does away with lugging around a cumbersome tank on the shoulders of two men. It works equally as well on any smooth floor.

A tank is dragged from storage by hooking the "L" hook

into the openings in the valve cap. It is then placed across the rails or on the floor in a position to roll. The valve cap is unscrewed a turn or so to form a groove for the ring to catch in, the ring is slipped over the cap up to the groove, the tank is then given a start with the foot and by shoving on the rod is moved rapidly and with ease along the track or

Device for Handling Oxygen Tanks.

floor. In case one side travels faster than the other a sudden jerk or shove on the rod will change its direction.

With a little practice a man soon becomes proficient in the use of this tool; it makes much easier work and saves valuable time. In fact, it has been proven that one man now moves the same number of tanks four formerly did.

PLACING ON NEW METAL WITH THE OXY-ACETYLENE TORCH

By F. H. Sweet

One of the most important uses to which the oxy-acetylene torch can be put is that of placing on new metal. It is melted on, little by little, the new metal coming from the welding rod. This procedure is especially valuable in a repair shop. A threshing machine breaks down because a gear wheel has broken a tooth; or a mowing machine has gone out of service because some small piece has been broken off and lost. The job is brought to the shop, where the operator uses the oxy-acetylene torch to build up a new tooth on the gear wheel, or to replace the piece lost from the mowing machine. The new metal needed is put on by the torch and the job is finished with the file or other tools.

Take another case. A hole has become too big in some part of an automobile. That is, because of wear and tear, the hole has gotten large. The rod or other part which works in the hole gives trouble because it is held too loosely. What is wanted is some way to fill up the hole with new metal and then bore it out again.

Consider still another example. A cam has become so worn that it no longer performs its duties. It needs to be built out again. That is, more metal is needed to replace what has been worn off.

In short, there are many, very many, cases where the repair jobs require new metal to be added onto the old. For this work the oxy-acetylene torch is very well fitted. But it is not everybody that makes a success of this class of work. There is little or no trouble in putting on the new metal. Trouble is to be looked for from two principal causes: (1) The new metal may not stick to the old; and (2) it may be difficult or impossible to shape the new metal on account of hard spots. There are also other points, but these seem to be the most important.

When new metal is to be added by melting it on from the welding rod, it is very important that the work be properly prepared. Suppose, for example, that one wishes to build up a blank gear tooth in place of one that has been broken out. The oxy-acetylene torch accomplishes a job like this by melting off metal from the welding rod and building up the tooth little by little. The first thing to do is make sure that the place on the gear where the new metal is to be added is good and clean. A cold chisel or a file may be employed to cut off metal and make sure of a clean spot. Sometimes, it may be difficult to cut away surface metal in order to expose perfectly clean material. Such a case might arise, where a hole or casting had to be filled up. It might be awkward to use a cutting tool in the hole or cavity. Nevertheless, the operator is to remember that the work of preparing a thoroughly clean surface is important; so that, even if there is trouble, he is not to quit, but to try various ways until he succeeds.

After the torch has been properly adjusted, the operator applies it to the new and clean surface. Every spot of the surface of the work—every spot of it where new metal is to be put on should be carefully melted just before new metal from the rod is added. This means that, sooner or later, the whole surface that is to be built up is to be reduced to the molten state.

It is also important that a similar rule be adhered to when new metal is added to new. Thus suppose that a blank gear tooth has been built up half way, and that new metal from the rod is now always dropping onto new metal. The new metal underneath may have been in place for several minutes or longer. In fact, it may have solidified. If so, it is highly desirable, not to say necssary, that it be in a molten state when it receives other new metal on top of it. The torch is to be employed in re-melting the new metal already in place, if it has ceased to be in a melted condition. The rule still continues—melted metal is to be added to melted metal. When this is done, they go together and stick together.

The operator is cautioned not to neglect what has been said. Whether new metal from the rod is being added to the work itself or to other new metal, the thing to do is always to add melted metal to melted metal.

REMOVING A CAST IRON WATER MAIN

The problem of removing a 36-inch cast iron water main was recently simplified by using the oxy-acetylene torch to melt out the lead caulking between sections. It was found advantageous to adjust the acetylene supply to obtain a longer flame than that used for welding, in order to insure its penetration and the melting out of all the lead to the bottom of the joint. The operator begins at the top of the pipe joint and works down each side until the lead has been removed from about two-thirds of the circumference; after this has been done, the length of pipe is slightly lifted at the opposite end, and if necessary wedges can be placed on the inside of the end to be removed, so that when the pipe section is lowered it readily draws the joint away. The molten metal flows in bulk and is easy to collect, so there is no waste.

A one-story building has been contracted for at 4613 Broadway, Cleveland, by the Aetna Welding Co., that city, to house their new welding shop.

The Welding Engineer

Reg. U. S. Pat. Office.

Published on the 17th of Each Month by

THE WELDING ENGINEER PUBLISHING CO.,

608 S. Dearborn St., Chicago, Ill.

Telephone Wabash 7134.

L. B. Mackenzie.....President and Editor
H. S. Card.....Associate Editor
R. L. Miles.....Associate Editor

Subscription payable in advance and postage free.
United States and possessions and Canada.....$3 a year
Foreign Countries ..... 4.00 a year
Single copy, domestic .....25 cents
Single copy, foreign .....30 cents

Entered as second-class matter January 20, 1916, at the postoffice at Chicago, Illinois, under the act of March 3, 1879.

The Welding Engineer is a member of the Audit Bureau of Circulations and of the Associated Business Papers, Inc.

Last Advertising forms close at 8:00 a. m. on the 15th. To show proof for correction copy must be received at an earlier date and allowances should be made for delay to mails.

The Welding Engineer is the official organ of the American Welding Society.

Eastern Office:
171 Madison Ave., New York. Telephone, Murray Hill 4394.
Max I. Barth, Eastern Representative.

The Welding Engineer in Australia and New Zealand.

Mr. R. Hill, Matlock House, Devonport, Auckland, New Zealand, is our accredited representative in Australia and New Zealand for obtaining new subscriptions.

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Membership Should Mean Service

NEXT month, the American Welding Society holds its annual meeting at Philadelphia, and a vigorous effort has been put forth to secure a program that will make the meetings well worth attending. Undoubtedly some critically inclined members will be ready to question, "What has the Society done this year?" But the Society has beaten them to it, asking "What have you done?" Papers and discussions have been earnestly solicited. This request for contributions to the program gives every member a chance to put something into the event. No member discharges his full obligation to the organization by simply paying his dues. The gospel of welding must be preached, and the art of welding developed; and this cannot be done by depositing checks in the treasury. There is work to be done here. Surely every member should feel obligated to take a hand and "do his bit" if it is only a small bit.

The Welding Foreman

IN large manufacturing plants, the welding foreman has almost unlimited opportunity to increase the scope and usefulness of his department. His responsibility does not cease with keeping welders busy and checking up on the quality of their work. A daily trip through any large plant will bring to light many ways by which the welding equipment will provide short-cuts in production. This is particularly true where a blacksmith shop or pattern shop form part of the plant. The welding foreman who is "on the job" will spot many an old-fashioned process which should be displaced by the welding torch, the cutting torch or the arc welder. Welding thus assumes increasing importance in the plant, and the foreman enjoys increasing confidence and respect on the part of his employers. The right kind of foreman is usually found to be a close student of his work, one who studies both improvements and new applications of the processes which he is called upon to supervise.

Not So Far from Normal

TWO years ago business was good; it was flourishing but it was not normal. Selling was a matter of promising delivery. The good old American fighting type of salesmanship was not needed in the field, and the American type of executive was not needed in the factory, for in the field there was no difficulty in finding buyers and in the factory increased costs could be met easily by sky-rocketing prices. The laborer called for more pay and got it promptly—only to be met at his door by the landlord bringing notice of a rent increase. The bubble kept on swelling until it burst. Buyers are not so eager this year, but business is *nearer to normal*. It takes real management to conduct a business at a profit, and it takes real salesmanship to produce orders. Let it be remembered that the man who sighs for the "good old days" is usually thinking of the easy money days of the period of the world war, and that if he had put in some time in the trenches he wouldn't be sighing for more of it. Looking back into the normal business conditions preceding that period, it will be remembered that honest profits had to be earned, not merely collected. Business is nearer to normal because its leaders are scrutinizing carefully every proposed expenditure and every method of production. There is evidence of this in the lively demand for information and data relating to welding processes. The necessary equipment will be purchased as soon as the expenditure appears to be justified. It is a good time to keep everlastingly at the educational publicity program. The prospective buyer has time to listen, and if the facts point toward efficiency it will usually turn out that he also has the money to buy.

Setting the broken nose of commerce

THE oxy-acetylene welding and cutting torches—those twin metal surgeons—are indispensable in ship yards.

Wherever metals must be cut or joined neatly, quickly and economically the oxy-acetylene process is invaluable.

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WHAT IS AN EXPERT WELDER?

Editor:—

For the past year I have been an interested reader of *The Welding Engineer,* and have found many good articles.

At this time, throughout the upper part of this country, there is a serious drawback to welding. It is in the garages, and all through the men that claim to be welders. It is for this reason that I am writing this letter hoping to get some one else's idea on the subject, and see if there is any way to overcome it.

I have welded for large factories, in railroad shops, and have also run a welding shop of my own. I have never welded in a garage because you have to be an auto mechanic to get the job, and the managers say that any mechanic can do the welding, and some of them even boast that I, myself, showed the last mechanic that came to work for me how to light the torch and he has been doing the welding ever since. Hearing a good deal of complaints about welding by the people of various communities up the line, I decided to investigate, and this is what I found.

Signs on garages say "Expert Welding Done Here." On one occasion I walked into a garage to have a talk with the expert to see if I could learn anything new about welding. This certain expert that I have in mind was welding malleable cast iron with common cast iron, and making a very poor job of it at that. I thought this would be a good chance to help the industry a little, so I went up to this fellow and asked him if I could explain to him another way of doing it so that it would hold a good deal better. He asked me if I was an expert. I told him no, but that I had done a good deal of welding, and understood it fairly well. He looked at me with a sneer and said:

"I consider it unwise to take advice from some one that don't know as much as I do about a thing. So I make it a practice to take advice only from an expert."

I controlled my temper enough to ask him if he took any Trade Journals. His reply was:

"Of course not, I consider a practical man is foolish for wasting his time on such trash."

I left him with a "Goodbye, stranger, I hope you come to your senses before it's too late for the welding game."

After I left the garage I decided to inquire and see how his customers liked his work. I found a man that he had done a job for. The fellow said it only held a couple of days. I suggested to him that perhaps it was only a poor job of welding. The man didn't hesitate to tell me that an expert had done the work, and it couldn't help but be a good job. He said that when he went back to the garage the man was honest enough to admit that the process was no good. Imagine an expert admitting that. This same expert, he claims, advised him to buy new parts, it was cheaper than getting them welded. I had a talk with the manager of the garage after that and he gave me to understand that the man he had hired couldn't be beat when it came to welding.

In another garage, on my trip of investigation, I found a new outfit. I went to the manager and asked him what kind of luck he was having with his outfit.

"Not very good," was the answer. "I guess I got stung on my outfit."

I then asked him who he had doing his welding, and how long he had been at it.

His reply was, "My mechanic, he just started welding when I got the new outfit about two months ago."

I asked him why he had that sign—"Expert Welding Done Here."

"You have to," he said, "in order to get the peoples' trade."

He asked me if I was an expert. I told him I was not, and he sighed and said he wished I was, as he had a job they were stuck on, in fact, they thought it impossible to do. I asked to see the job, and found it to be a couple of cast iron wheels off from a combined harvester. The mechanic had tried it a couple of times without even preheating it. Of course it broke when cooling. I told him I would do the job for him, and after it was done and found to be all right in every respect, he wanted me to work for him. I would have liked to have gone to work for him, but at that time was unable. I told him that if ever I did work for him he would have to take down that sign—"Expert Welding Done Here," for at that time I was far from one. When I came through the town on my way back I found that the sign had been taken down. The mechanic also said he was going to subscribe to some trade Journals, and I gave him the address of a couple of good ones.

And another case I wish to mention before I close, is that of a large farmer that would have two or three hundred dollars of welding every year, if it wasn't for the fact that he now buys new parts. In a conversation with this fellow he told me how he used to have his broken parts welded by an expert in town, but that they had only broken again, without gviing him any service whaetver. I asked him if he didn't believe it was the fault of the fellow that welded it. No, he claimed it was all the process, and I couldn't convince him that the process was not to blame. He was done with welding entirely. This man, I speak of, is not the only one all along the line. If a good welder was to start a shop in any of the communities I speak of he would have to have enough money to carry him over for a couple of years, until he had won the confidence of the people back to welding again.

Hoping to hear your opinion on this subject, or some other welders from different parts of the country, I remain,

Yours very truly,

C. D. Bradley.

A NEW IDEA IN CHAIN MAKING

With the large number of improvements in electric welding, the trade is now being supplied almost universally with electric weld chain in all the smaller sizes up to ½-inch and ¾-inch material.

There are a number of different methods of forming and welding the links but in all cases there is a flash of material at the point of welding brought about by the intense heat of the electric current and by jamming the two ends of material together when the weld is accomplished. Some manufacturers have left this flash, or swell, without trying to remove it because of the extra strength that it gives the weld, while other manufacturers have invented means of either grinding or shearing the flash away so as to make the link smooth at the welded point.

New Type of Welded Chain.

A new method of electric welding has just been completed by which all of the material at the flash, or welding point, is retained, but by a special device is forced to the inside of the link; thus retaining the strength at the weld that was formerly retained by leaving the swell all the way around. An illustration of this new method of welding is given, which indicates very clearly the form of the link that is thus secured.

The Manufacturers of the Chain claim that by this method the welded portion is twenty-five per cent stronger than any other part of the link and repeated breaking tests have shown that the material will pull out at all other places than the weld when tested to destruction. This kind of Chain is very smooth on the outside of the links and the swelled portion on the inside of the link gives it the additional strength. The method of

Why Send Your Regulators to the Manufacturer, Then Wait Weeks for Their Return?

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WRITE FOR CATALOGUE

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VALVES that stick, and then open suddenly, shoot too much gas into the regulator, and the effect on the mechanism of the regulator is the same as that of a hammer blow. Burdett Special High Pressure Valves are designed to eliminate this important source of regulator trouble. They open easily and smoothly —and they positively cannot leak.

A greater saving can be accomplished through proper valve construction than most users imagine. It is a subject worthy of serious consideration, and it has been studied carefully in the development of Burdett Special High Pressure Valves. We will welcome an opportunity to supply you with complete construction details and to explain the numerous economy features of these valves.

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Hold on! What were you doing just then? Storing away that interesting bit of welding experience, or a photograph, perhaps? Don't do it? Give it to us. We want to show it to 5,000 other readers of The Welding Engineer (you're the fifty-one hundredth). If there are objectionable features to it, just leave it to the Editor (he studied surgery), cutting off and adding to is his hobby.

Another thing, when you work out a successful solution to a welding problem write us about it. Grammar and composition don't count—it's ideas we want. If a sketch would illustrate your job in good shape, just make a rough pencil sketch; our draughtsman will do the rest.

If the welding industry is to grow, you welders must pass along your experiences. We pay for them.

THE WELDING ENGINEER

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Every Johnston Welding Goggle

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STYLE No. 444 PATENTED

Do you know that this washer, which is placed between the scientific Weldoglas lens and the exterior cover glass, does have a big bearing on the life and efficiency of the goggle? It not only makes the goggle cooler, but prevents scratches while cleaning and eliminates those little disagreeable and oily appearing rings which are known to opticians and scientists as Newton's Rings. If you sell welding supplies or employ welders it will pay to investigate. Order TEN pairs No. 444 welding goggles and see the difference.

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manufacturing to this special pattern is patented and the name "Inswell" has been copyrighted by the manufacturers, The Columbus McKinnon Chain Co., Columbus, Ohio.

All links are of equal length and width and show practically no variation. The chain is entirely free from twist. The weld is the strongest part of the link and when the Chain is pulled to destruction it will always break at some other point, thus giving the Chain the full strength of the bar from which it is manufactured.

WELDING OIL CONTAINERS

Readers of oil publications are generally familiar with the use of oxy-acetylene welding throughout the industry, where it has extensively displaced threaded connections in pipe line construction and promises to supersede to even a greater extent the old method of riveting once commonly employed in the building of storage tanks of all kinds and sizes, due to the economy and higher efficiency of the welded joint.

In its more recent development the process has been successfully applied also to the manufacture of the more intricate fabrications required in plants for the fractionation and refining of crude oils. Two very interesting examples of these later applications are shown in the accompanying illustrations.

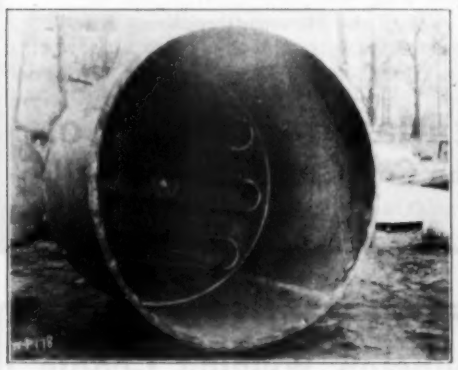

Fig. 1. General Interior.

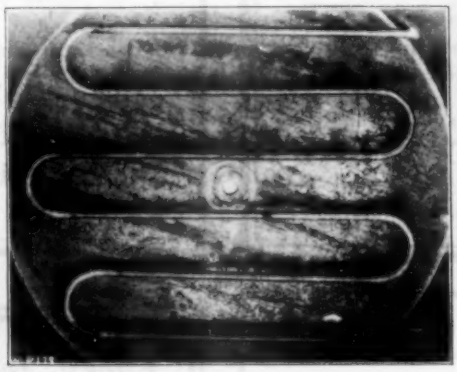

Fig. 2. Close-Up of Welded Construction.

Fig. 3. 60-Inch Gasolene Still Gas Welded.

Figures 1 and 2 show the general interior and a close-up of welded construction of a one-piece mixing kettle for compounding oil. Both the outer shell and the steam coil are of oxy-acetylene welded fabrication. The shell is composed of 3/16 inch steel plates, reinforced with two by two by quarter-inch angle, rolled to proper diameter and tack-welded to the upper edge of the shell.

Figure 3 shows a gasoline still, 60 inches in diameter and 16 feet long, built of quarter-inch steel plates with flanged and dished heads. An 18-inch cast iron screwed-top manhole, two 6-inch pipe connections and one 24-inch (diameter) drip pot, are welded on. On the outside are pipe hangers and angle iron supports for absorption plates, five baffle or "swash" plates and the necessary welding to hold them securely in place. The baffle plates extend approximately two-thirds of the width of the tank's diameter, are staggered on three foot centers, and are tack-welded to the wall of the still. They conform to the curve of the tank wall from the bottom to a point near the center line.

The photographs and details regarding these interesting applications were furnished by Mr. Everett Moses, president of the Welded Products Company, Birmingham, Ala.

BRITISH COMMENT ON CAST IRON CUTTING

In a recent issue the editor of "Industrial Gases" makes some interesting comment on papers that have appeared dealing with the subject of cutting cast iron with oxygen, as follows:

Cutting Cast-Iron with Oxygen.—Two widely published papers on this subject have recently been read in America, the first by Mr. F. J. Napolitan of the Davis-Bournonville Company, and the second by Professor A. S. Ramsey, of Steven's Institute of Technology, Hoboken, N. J.

We have studied both papers with much interest, because we think it is undeniable that on this side of the Atlantic no one has yet devised a satisfactory solution of this problem. There has been no lack of effort, but we doubt whether any careful scientific research has yet been made as to the metallurgical conditions involved. Most investigators have been content to accept as the reason of their unsatisfactory results in the cutting of cast iron with oxygen the usual explanation, that, as the melting point of cast iron, unlike that of wrought iron and steel, is lower than that of the oxide, the ordinary cutting effect by oxygen is unattainable.

Mr. Napolitan, as a result of his investigation, appears to have discarded that view. He says: "Most of us, and I am no exception, have expressed at some time or other in our experience the solemn opinion that cast iron could not be cut because the oxide of iron melted at a temperature higher than the cast iron itself." He then adds: "Not only does cast iron burn to form an oxide, but the higher melting point of the oxide probably assists the reaction." What this precisely means is not made clear, but we do not think it has ever been denied that the burning of cast iron resulted in the formation of an iron oxide. Such a reaction appears inevitable where an oxygen jet is impinging on the molten metal, but how the higher melting point of the oxide can assist any reaction which has cutting for its object is not easy to understand.

Whether carbon is present in iron in the form of cementite, pearlite, or even graphite, whether it is grey or white cast iron that is being dealt with, appears to us relatively important for we assume that the quantity of carbon in the iron is the crux of the matter. Mr. Napolitan himself says that "as the carbon content is substantially increased an equivalent interference with cutting is apparent until when the carbon content approaches 2.5%, cutting becomes so labored as practically to cease." Then later he says: "Long before the point of fusion the carbon and iron oxide exist in one relationship, that of austenite."

These statements appear only to confirm the view we have always held, which is that with the oxygen cutter cast iron must always be brought through a molten condition which renders unimportant the state of combination of carbon in the cold metal, before any cutting effect due to the formation of oxide can be established.

In America the term "burner" is usually applied to the oxygen cutter. Although that name may correctly define the instrument in its relation to wrought iron and steel we are inclined to regard it as somewhat of a misnomer where the cutting of cast iron is concerned. The burning of metal implies its rapid oxidation, and the success of oxygen cutting

depends on the quick production and dispersal of this iron oxide. We have always regarded the cutting of cast iron as due more to a local melting of the metal, through the intense heat of the blowpipe, than to any subsequent formation of oxide by means of the oxygen jet. We have considered the chief value of the jet to lie in the fact that it blows the molten metal away, and clears more surface for the blowpipe to melt. In so far as it promotes combustion of the molten metal and consequently the gradual formation of oxide, it is even possible that this is more harmful than beneficial, as it largely results in the production of slag. This is apt to prevent the free discharge of molten material from the slot, or kerf, which the blowpipe is creating, and thus impedes the progress of the operation.

It is right to state here that neither Mr. Napolitan nor Professor Kinsey appears to share this opinion. We have already quoted a statement by the former, which indicates his belief that the cutting of cast iron is effected by the formation of oxide. It is, however, Mr. Napolitan's view that the main solution of this problem is to first overcome cutting difficulties, due to carbon formations in cast iron, either by preheating the metal itself or by preheating the oxygen used.

On the other hand, Professor Kinsey attaches no importance to preheating—and we confess our own limited experience confirms that view,—but he advocates a long heating flame in the cutting blowpipe with an excess of acetylene, so that when the high pressure oxygen is turned on there is a carbonising jet penetrating from one to two inches into the kerf. Professor Kinsey found that "while a pure reaction in cast iron cutting similar to that obtained in cutting steel seems impracticable, it is possible to bring about a combined burning of the ferrite and melting of the oxide so that a comparatively satisfactory cut can be made through cast iron." He believes this to be due principally to two conditions: (1) "The unusually large supply of oxygen and acetylene used; (2) the additional fire created in the kerf by the excess of the acetylene from the torch, the carbon in which is in the finely-divided particles so likely to produce a large volume of heat in the shortest time." He has found that for cutting cast iron much higher gas pressures are required than for steel, the quantity of oxygen used being nearly five times and acetylene ten times as much, whilst the kerf is three to four times wider, and its surface much rougher.

We venture to think that there is nothing in the method of working described by Professor Kinsey which is inconsistent with our own view of this matter. The high pressure of the oxygen jet and the quantity of that gas used as compared with ordinary cutting indicate a consumption which largely exceeds that required to burn the metal. Some of this additional oxygen no doubt combines with the excess of acetylene to generate more heat in the kerf, but most of the gas is probably required to disperse the slag in order to expose fresh metallic surfaces to the heating flame. We can quite believe that the cutting conditions employed by Professor Kinsey "bring about a combined burning of the ferrite and melting of the oxide," and it is quite possible that no better method can be used. At the same time we think neither Professor Kinsey nor Mr. Napolitan has disproved the fundamental fact that cast iron melts at a lower temperature than its oxide. On the contrary, the difficulties they have experienced appear rather to demonstrate its accuracy.

It is obvious that further improvements are required if the cutting of cast iron by oxygen is to be commercially successful, and the subject is an interesting one for investigation. For instance, may it not be possible that, if the molten metal which is first produced could be swept out of the kerf without any appreciable oxidation, better results could be obtained? It is, of course, a prime necessity to maintain the requisite melting temperature as the kerf deepens, for which purpose oxygen is doubtless required. It may be, however, that this is a case where a low grade of oxygen might actually produce better results than high quality gas, and it would be interesting to know whether the cutting of cast iron has ever been seriously tried under these conditions. If in Professor Kinsey's experiments a jet of hot air had been substituted for the oxygen jet, it occurs to us that, whilst the oxygen of the air might suffice to maintain the requisite heat in the kerf by burning the excess acetylene, the residual nitrogen would be available to discharge the molten metal without tending to obstruct the passage by converting it into an oxide slag. Such a jet might also be tried intermittently and not as a continuous blast. If, on the other hand, experience proves that burning by means of oxygen is necessary, it is possible that some flux which would facilitate the melting of the oxide might be advantageously employed.

These observations are only put forward as indicating lines of investigation which we consider worth following up. Meanwhile, all users of metal-cutting apparatus are indebted to Professor Kinsey and Mr. Napolitan for their valuable contributions to the solution of this subject, and we regret that we are unable, through lack of space, to publish their papers.

OPENING CYLINDER VALVES

Editor:

In reading the July issue of *The Welding Engineer* we noted under "Hints for the Welder" that a writer in "Industrial Gases" advocates the opening of cylinder valves before returning them to be refilled. It appears to us that this suggestion is a little ambiguous. Does the writer advocate simply the opening of each valve to see that the cylinder is empty, or does he advocate leaving the valve open during transit?

If the latter is true, we beg to differ with him. Those of us engaged in the oxygen and hydrogen gas manufacture are using every precaution to compress into the cylinders gas of the highest possible purity and consequently efficiency, and we are shipping gas by test with less than ½ of 1¼ impurities and less than 2/10 of 1¼ of hydrogen in oxygen and *vice versa*.

We have demonstrated by test that when valves are left open during transit the "breathing" of the cylinder due to changes of temperature causes diffusion with air resulting in a marked lowering of the purity of the next charge.

Gas users should be cautioned *against* such a practice; at the same time we heartily agree with the writer that only *empty cylinders* should be returned to filling stations when shipped as such.

W. E. Curry.

Note: The writer of the article referred to above does not advocate shipping back cylinders with valves left open, but simply opening valves long enough to make sure that they are empty. However, Mr. Curry's discussion contains words of caution that every gas user should read and heed.—Editor.

The Lumen Bearing Company of Buffalo, N. Y., and Youngstown, Ohio, manufacturers of brass and bronze castings and bearings, solders and babbitts, have located in Chicago a branch office that will supply and handle all business of the company west of and including Michigan with the exception of the city of Detroit, and west of a line from Toledo, to Columbus, to Cincinnati; Kentucky, Tennessee and Georgia. Mr. H. S. Huncke is the western sales manager, with Mr. Henry Waters as associate salesman. The office is located at 15 N. Jefferson street, Chicago.

Meyer L. Levy, 125 Somerset Street, Newark, N. J., heads the newly organized M. L. Copper Welding Works, of that city. The plant will be located at 207 Sixteenth Avenue, Newark.

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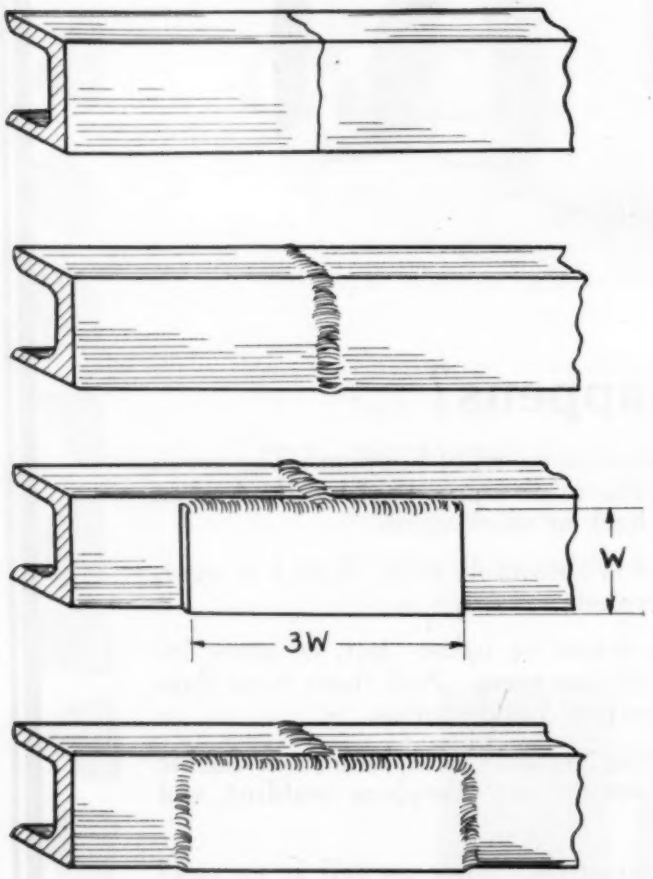
AUTOMOBILE CHASSIS REPAIRS
A New Method

By B. Heymann

CONSTANT vibration, coupled with frequent unusual and severe stresses due to passing over rough and uneven surfaces, defective workmanship and materials, or mishaps of various sorts that are common to automobiles, generally result in badly fractured chassis frames. So common are these occurrences that the average job welding shop has begun to find chassis repairs the source of a very profitable income. And, in the main, such fractured frames are handled skilfully and with unquestionable results by oxy-acetylene welding. The break is tacked and the channel reinforced by a plate welded either on the inside or outside of



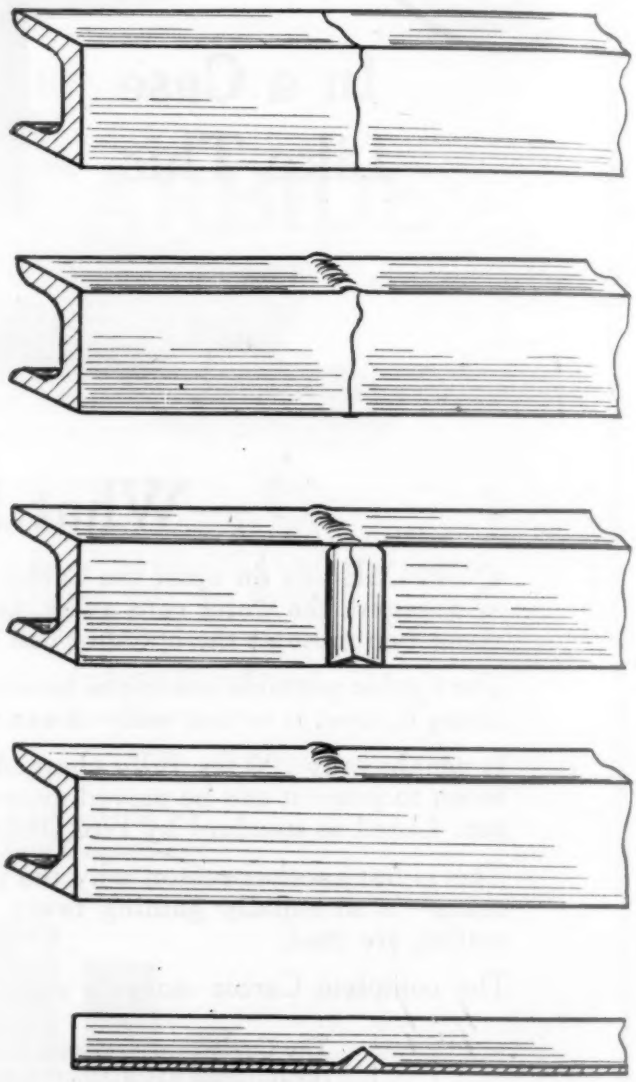
Patch Method of Chassis Repairing.

the frame, depending upon which is the most convenient position.

It is, of course, possible to replace the old frame with a new one. Such a procedure would be very costly, entailing dismantling the entire machine, the cost of new parts and finally, assembling. Furthermore, the delay itself might be prohibitive, as in the case of trucks used daily for transportation purposes. The time given up to repairs in such a case might in itself amount to as much as the cost of the new frame and the entire labor required for dismantling and assembling.

Compare with this procedure the simple remedy of running the damaged car into a welding shop where the break is repaired in as short a time as one-half hour where no stripping is required, or perhaps one-half a day when the break has occurred in some inaccessible place.

Frequently the frame is so fractured, that the car must be partly dismantled. When the weld is in the neighborhood of the radiator it is advisable to remove the radiator entirely to prevent melting out the solder. Likewise, work in the neighborhood of the gasoline tank should never be undertaken unless the gasoline tank is removed. Even when the weld is to be performed at a distance from the radiator or gasoline



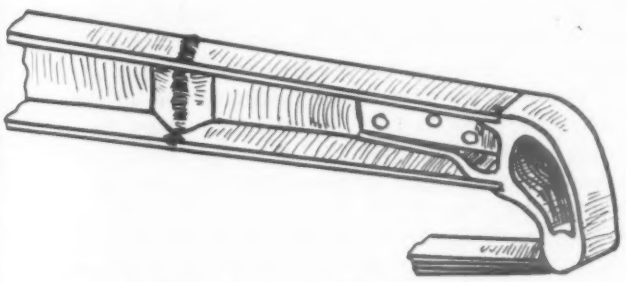
New Method of Chassis Welding.

tank it is safer to protect these parts with sheet asbestos. If the break is near the carburetor, it should be drained. All oil soaked parts of the machine should be protected with sheet asbestos. "Safety first" should be the foremost consideration, even though its observance entails a slight expense or additional trouble. The prevention of possible damage and the elimination of fire and explosion hazards are well worth it.

The customary method of handling a fracture consists in aligning the broken members. The frame is jacked into position with the fractured cross-sections exactly in their relative positions. The surfaces adjacent to the break must be thoroughly cleaned. All dirt, paint, oil, and rust must be

removed. It is possible to do this most effectively by applying the torch flame and scraping with a flat-edged tool.

The fracture is then welded according to the procedure generally followed in the case of any steel weld made with the oxy-acetylene process. A pure iron filler rod (Norway iron) should be used and should be added to the break starting at the bottom flange of the channel, then vertically upward, and finally along the top flange. This means one overhead, one vertical, and one horizontal weld, but there is nothing exceptionally difficult in any one of the three and any skilled welder should be able to execute them. It is, however, of utmost importance that the vertical weld be started at the bottom and that the weld be executed upwards. This eliminates any incorporation of gases in the weld as would be possible were the reverse method followed. A perfectly neutral flame must be maintained. Even a slight deviation from the neutral composition will affect the soundness of the weld by either carbonizing or oxidizing it. Hammering the weld materially improves it and is advisable.



New Method Applied to Goose-Neck Entirely Broken Off.

A weld finished as above described can be made as strong or even stronger than the original material by adding to the cross-sectional area. Although permissible and to some extent utilized this practice is not generally followed and it is deemed safer to reinforce the weld by tacking a plate across the welded joint. This plate should be of the same thickness as the channel frame and about three times as long as it is wide. The width of the plate is governed by the depth of the channel. Usually it is welded to the inside of the frame but occasionally the fracture occurs at a point where a cross-member is riveted to the channel and this necessitates welding the plate on the outside. The horizontal welds are made first and the vertical welds last, these being executed in an upward direction. Sometimes the reinforcing plate is made in the shape of a channel section which just fits inside the automobile frame. Although this construction is very neat in appearance it does not materially aid so far as strength is concerned. A flat plate is enough to make the repaired section far stronger than any other part of the frame.

The above method is classed as the standard, but a new method is coming into vogue and is displacing the use of the reinforcing plate. This is especially true in the case of the lighter pleasure cars where the load and shocks are not as great as in the case of large heavy trucks.

The procedure consists in jacking up the frame, aligning and cleaning the break and adjacent surfaces. The top and bottom flanges of the channel are then welded and slightly reinforced by means of additional filler rod. The channel sections adjoining the break are then heated with the torch to a dull red and hammered in, to form a "V" shaped depression of very obtuse form. The "V" is generally started about one inch to either side of the break and is made about ⅛ inch deep. The vertical weld is then made as though the two pieces were heavy steel plates beveled and prepared for a vertical weld. Or better still, assume that the channel is a broken casting with a fracture which has been beveled out leaving a depression 2 inches wide and ⅜ inch deep. Using Norway iron filler rod and beginning at the lowest point, steel is added to the frame layer upon layer until the "V" is completely filled. It is essential that the rod be properly fused and so incorporated that the layers lap and form perfect unions. The surface is smoothed down with the flame and can be filed flat after cooling.

This method produces a column of much stronger section than at any other point of the chassis frame and one that will outlast the machine itself. It eliminates the use of steel plates. Furthermore, it leaves a smoothly finished exterior (which is not always possible by any other method), a very important consideration in the case of pleasure cars, where appearance counts.

Too much cannot be said about carefulness in executing chassis frame welds. In the case of trucks the body is generally removed and the job completed without any difficulties. On the other hand pleasure cars are prone to offer many difficulties. It does not take much heat to scorch the enamel off the body and the owner surely has a right to look askance at the welder after such an occurrence. Other damage can easily be produced by carelessness.

The writer has seen a beautiful Lexington model lose all the rear upholstery simply because the welder was too lazy to insert a piece of sheet metal over the frame to protect the car from the flame.

The use of powdered asbestos well soaked with water is a very useful aid in protecting parts adjacent to those being welded. There should be no skimping on the part of the welder in applying this material as it may be the means of saving himself much trouble and expense.

ALUMINUM WELDING

In performing welding jobs, such as on aluminum crankcases, the following kink, given by a writer in the *Journal of Acetylene Welding*, can be used to advantage. Oftentimes it is required to weld a large hole, in which case a chill of galvanized iron is provided, backing up the hole and welding against this when filling the hole with aluminum. Galvanized iron is preferable to any other material, such as tin or iron, since it peels away from the aluminum quite readily, and can therefore easily be removed after the weld has been completed. This is undoubtdly due to the zinc content of the galvanizing composition.

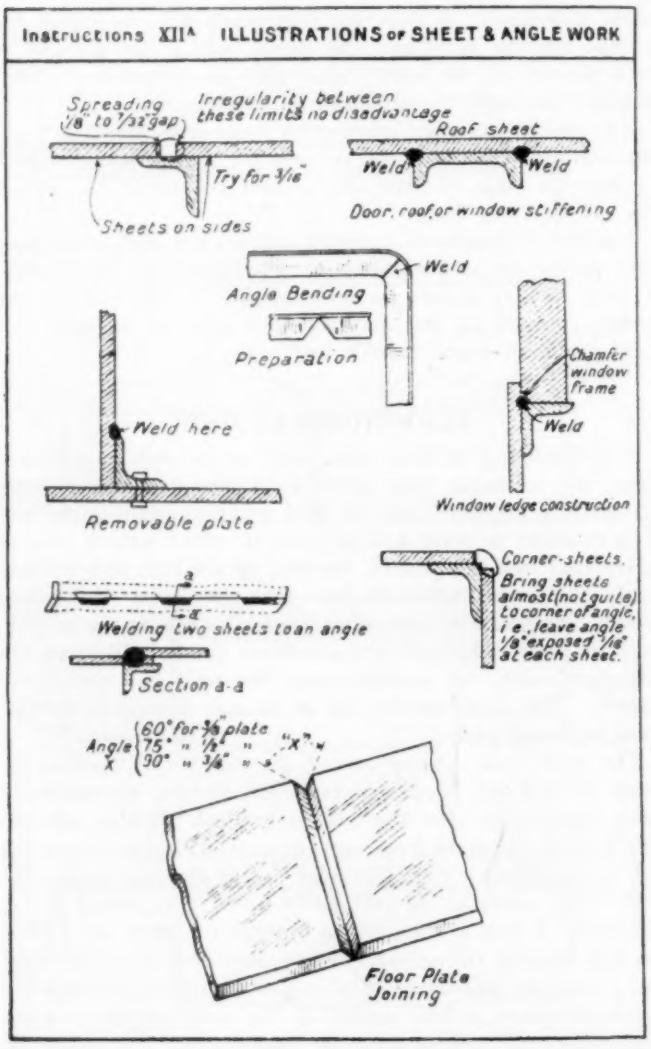
The chief value of the use of the chill is that it causes the filler to cool and harden prematurely, thereby preventing it from contracting after the weld is finished. It also prevents the heat of the weld from spreading, which might cause the job to crack back. The chill is fastened in place by a wrought-iron scrap, made in the shape of a boiler crab, which arches the hole. A hole is then drilled through the strap and a similar one through the galvanized-iron plate, the two being fastened together by means of a bolt and nut. In making the weld, the metal is first applied to the inner corners and the space filled up by working toward the center. Just before the center is reached, and when it is impossible to add any more metal without touching the bolt, the strap should be loosened, the bolt removed, and the hole filled with the molten metal. Greater success will obtain if the work is done quickly, handling as large an amount of molten aluminum as possible at a time and covering the entire surface of the galvanized chill in a few minutes. The chill causes the added metal to cool almost as fast as it is connected to the edge of the break. After the weld has been finished and cooled, the chill can be removed by gently prying it away from the weld by means of a cold chisel. The flame of the torch should be kept in motion while performing the work, and should not be pointed toward the weld, but rather across the melting portion; otherwise it is almost certain that the flame will not only injure the metal, but will also burn away the galvanizing if pointed directly toward the weld.—*Mechanical World, April* 29, 1921.

SHEET AND ANGLE WORK

On page 50 of the July, 1921, issue of The Welding Engineer, the instructions from the handbook of the Electric Arc Cutting & Welding Co., printed under the title, "Useful Arc Welding Applications," were made somewhat confusing by the omission of the illustration which is reproduced herewith. For this reason, that part of the instructions which refers to the sketches of sheet and angle work is repeated below.

The illustration on the sheet and angle work show some special applications of joining two or three or even more of the regular structural members for structural work.

When joining two plates at an angle, if the sheets are left a bit spread the pieces can be joined reliably in the one weld. The wider the plates are apart, the more reliable will be the


Instructions XII^A ILLUSTRATIONS OF SHEET & ANGLE WORK
Spreading 1/8" to 1/32" gap
Irregularity between these limits no disadvantage
Try for 3/16"
Sheets on sides
Roof sheet
Weld
Weld
Door, roof, or window stiffening
Weld
Angle Bending
Preparation
Weld here
Removable plate
Chamfer window frame
Weld
Window ledge construction
Corner-sheets. Bring sheets almost (not quite) to corner of angle, i.e., leave angle 1/8" exposed 1/16" at each sheet.
Welding two sheets to an angle
Section a-a
Angle X (60° for 3/8" plate, 75° " 1/2" " "X", 90° " 3/4" ")
Floor Plate Joining

joining of the inner three pieces and at no time should the plates be apart a smaller distance than their thickness. The illustration to the right of this shows a method of stiffening a sheet either for attaching to an upright or not.

The angle bending and welding method shown in the center top is one of the most widely used applications of arc welding, but is shown as an idea to extend the arc as arc welding is only started. You will note that any angle can be allowed for by cutting out the "V" to correspond. The illustration to the left of this shows a method of joining by a combination of arc welding and bolts, members which must be removable.

The window frame method itself is self-explanatory, it being found much easier to chamfer off the edge of the window slightly than to cut out the corner of the angle and try to make a flush weld and perhaps ending by having to chip the weld afterward. The corner sheet method is very similar to the joining of the three pieces explained at the start of this section. A weld made in this manner and finished off a bit is the prettiest joint yet devised.

Where an angle would be objectionable or the plates are small the weld can be made from the inside forming an angle of the weld with the two plates. The plates can then be butted on the outside at a right angle and not welded at all or just welded for finish only.

A unique method of welding is shown to the left of this where a lapped joint must be made for a third member and the three of them joined. The illustration shows how one of the plates is nicked out and the other one laid over the notch half way the width of the notch so that the weld can be made through this opening to the third member, at the same time joining the two sheets.

The illustration of the veed out plates is shown for several reasons, one that the angle of the "V" must vary with the thickness of the plate for an even flush butt weld, being thicker for heavy plates. In general, however, a right angle opening is the maximum required.

Welding long seams butted brings up the question of the rigid or non-rigid method. In the rigid method the plates are clamped or bolted in their final alignment and the weld made in any manner, either continuously or broken up to spread the resulting contracting stresses over more time and plate. In the non-rigid system the plate is placed close together at one end and the part at the other end and the weld made continuously closing in the opening at an even rate which will just bring the closed ends together at the finish of the weld. This method requires more skill and experience than the non-rigid and in any ordinary job is not worth the trouble it entails, although for very careful work it may be desirable to use it where joining two pieces only.

It is evidently more out of place in setting in a patch as the only part of the patch on which this method can be used would be the first seam. There is a use for it, however, even in setting in patches in some very rare cases where the difference between success and failure depends on getting the first edge of the seam perfect so that it will not be pulled away due to the contracting strains when welding the opposite seams, or the seams at right angles which exert a more tearing pull than the opposite seams in contracting.

An aid which is hard to obtain, but which has been found very useful in very careful work is to vibrate the work while making the weld by light blows of the hammer or vibrating the work directly after the weld is made, that is, while it is cooling and contracting. The vibrations of an air hammer set for a light blow is the best means for accomplishing this.

REIHLE COMBINATION USES BRINELL AND SCLEROSCOPE TESTING FACILITIES

Heretofore, the Brinell and Scleroscope tests for hardness, have been made on two different machines. A recent development by Reihle Bros. Testing Machine Co., Philadelphia, Pa., combines the two operations in a single unit. Both weighing systems are supported by the same housing but the different working elements are on a turn-table. Thus the first test, whichever is desired, can be made and by simply revolving the turn-table, the second is brought into position.

Robert B. Dyar, formerly with the Air Reduction Sales Co., Chicago, has opened a warehouse and office at 2511 Clybourn Ave., Chicago. He will handle a complete supply of welding, brazing and soldering material.

PROCEEDINGS *of the* AMERICAN WELDING SOCIETY

33 West 39th Street, New York

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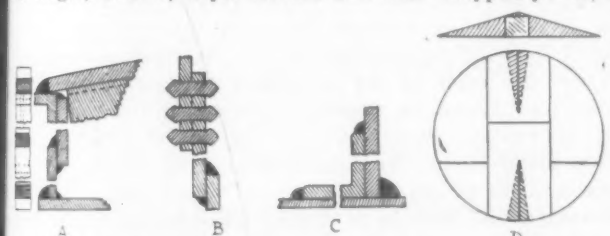
ELECTRIC WELDING OF OIL STORAGE TANKS*

By William Schenstrom†

Riveted Construction

RIVETED construction for oil storage tanks is the present standard. The details of construction are well known. In fabricating materials for the riveted tank, it is generally necessary to make templates, mark, punch and ream the plates. It is important that the edges of the plates are faired and that the size of the sheets is accurate. In erecting the tank it is necessary in many instances to drift. The plates must be drawn up tight for riveting. Neglect in any one of these things will produce an inferior article.

A number of joints are necessary in order to make the riveted construction possible, with angles, gusset plates, etc. The single, double, triple riveted and butt-strapped joints, as



A. Roof, Side and Bottom Welds of 500 Barrel Tank. B. Comparison of Rivets and Welds. C. Side and Bottom Joint of 5,000 Barrel Tank. D. Roof of 500 Barrel Tank.

the load may require, increase the possibilities for leaks. The possibilities of leaks increase with the number of holes and caulked joints.

The maintenance charges on a riveted tank start within one year of the construction of the tank. The bottom and first course of a riveted tank are constructed on horses and after test, this portion of the tank is lowered down into final position on the foundation. The strains in lowering this portion of the tank may cause leaks which cannot be discovered.

Leaks in Riveted Tanks

Leaks start when caulking edges have been strained unduly or often. Wind pressure, filling and emptying of the tanks, temperature changes causing breathing of the tanks and corrosion are some of the causes of leaks.

The loss through leaks, seepage and evaporation from riveted tanks has not yet been closely estimated but it is certain that the amount of the loss is tremendous, especially for the lighter grades of oil. One representative oil company roughly estimates its average yearly leakage loss at 5 per cent of contents of storage tanks, with a higher percentage for the lighter grades and a smaller percentage for the heavier grades of oil. It is the opinion of some experts that this estimate is too low. It is reasonable to assume from the above that the yearly loss through leakage on some types of oil will amount to 20 per cent of the value of the tank. Over a period of twenty years, this would amount to about 400 per cent of the value of the tank.

Welded 5,000 Barrel Oil Tank.

The oil industry has, with exceptional care and efficiency, developed in the refining of the crude oil, put tremendous investments into appliances which will extract a small additional percentage of lighter grade products from the crude. On the other hand, a very large percentage of these products is lost through the inherent deficiencies of the riveted construction of tank, in which they store these finished products. It has been determined that the deterioration of the tanks starts at the points where the skin of the plates is broken. These points are in the way of the riveted joints.

As an example of the deterioration of riveted structures being mainly in the way of the riveted joints, I would mention that recently a 220 ft. smoke stack showed considerable deterioration near the top. In drilling test holes and making a general examination of the smoke stack it was found that the deterioration confines itself practically to a belt following the outlines of the riveted joints. A number of the rivets could easily be knocked out with a hand hammer. The centers of the sheets were, without exception, practically as good as new. Therefore, it is to be assumed that tanks with the skin of the plates unbroken anywhere, will last longer.

*Paper read before the American Welding Society, Metropolitan Section, May 17, 1921.

†With Electric Welding Company of America.

Oil and grease are used for protection of tools and machinery against rust and the conclusion might be drawn that the oil would protect oil tanks from deterioration. However, the acids in some grades of oil attack the tanks and especially the rivet joints, and the tanks holding oils with a large proportion of acids, have been known to be useless after three years. The maximum life of a 55,000 barrel riveted tank, left in one position, is estimated at twenty years.

The general conclusion would be that the oil storage tank of the present standard and construction, while satisfactory for want of something better, has certain limitations, which makes an improved design and construction method desirable.

Electrically welded Construction

The electric arc welding method has for a long time been considered as the logical one to produce a more satisfactory

Making Side and Bottom Joint in 5,000 Barrel Tank.

construction than is possible with the riveting method. Recently considerable construction work of welded oil refinery equipment, including various sizes of oil storage tanks, has been successfully completed in the mid-continent, Southwest oil fields, as well as in the East.

In designing a welded tank it is proper to follow the fundamental outline, such as the lapping of the plates, of the riveted tank construction, for the present time. New methods of welded construction of tanks are now being developed, which will involve radical changes and seem to offer great possibilities. The only present variations are details and simplifications which are special to the adoption of the welded construction. These details include the elimination of rivet holes, butt-straps, gusset plates, angles, fairing of plates and a reduction in the laps of the plates. The plates do not have to be fabricated excepting in so far as the rolling is concerned.

Further, inasmuch as the welded lap joints are of 100 per cent or more strength, the plates in the shell can be lightened 15 per cent. The result should still be a structure 10 to 20 per cent stronger than the present standard of riveted tan

The thickness of the bottom and top plates is determin by practice and until it has been demonstrated over a peri of years that the corrosion of welded bottoms and tops less than that of riveted bottoms and tops, it is doubt whether it will be permissible to reduce the thickness of pla of this portion of the tanks. The skin of the plates of bo toms and tops being practically unbroken, it is reasonab to assume that these parts of the tanks will have conside ably longer life than those of the present standards.

Portability

By applying the oxy-acetylene torch in such a manner as destroy only the welding metal in the joints, it is possib to cut down welded tanks and erect them again the sam manner as is done with riveted tanks.

Engineering of Welded Tanks

At the present time, until standards have been develope for the welded construction of the various types and sizes oil storage tanks, considerable engineering is necessary each problem. Expert welding engineers are an absolu necessity for getting good results at the present stage development of this phase of the art.

It would seem a deplorable mistake if the users of o storage tanks would decide to go into this type of constru tion on their own hook at the present time as it would, doubt, give the electric welded design a setback such welding got in Europe many years ago when some fault welded containers in a power plant exploded, causing con siderable loss of life and damage to property. Welding that time being a new art on the continent, it was universall condemned and this has been one of the main reasons wh welding was not universally adopted on the European conti nent for years.

When such explosions happen on riveted containers, th public simply feel that the engineers and the workmen o this particular job were at fault and they do not for on minute think of condemning riveted construction in genera

These are some of the difficulties that a new art has t encounter. It would, therefore, seem that the conservativ way of building up a welded design of oil refinery equip ment, would be to turn this work over to expert organiza tions until the proper standards have been found.

Advantages and Savings of Welded Construction of Oil Tanks

It will be years before the advantages of the welded con struction can be fully determined. However, there woul seem to be a few advantages apparent now.

The electrically welded tank is a homogeneous structur throughout and can be generally characterized as being superior article to tanks built by any other means. All joint throughout are 100 per cent strong. The joints are absolutel tight and will stay tight over a period of years and after number of temperature changes and after the tanks have bee filled and emptied a number of times. No initial strains ar put on the bottom, as it is welded in place.

The life of a welded tank must be estimated as being a least twice that of a riveted tank, for the reason that the ski of the plates is not broken, and because the volume of the welds provides a much larger factor of safety against cor rosion. Welded tanks built on a concrete foundation can b set right on this foundation without an intermediate layer o cushion. Riveted tanks will, if set directly on a concrete foundation, rest on the rivet heads and cause undue strain on these. The electrically welded roof construction is gas tight and as is known, the saving in insurance premiums on gas tight roofs is considerable. In fact, after the advantages of the welded construction have become more generally known, it is reasonable to assume that the insurance premiums on welded tanks will be lower than those on riveted tanks, on account of reduced fire risk.

Paint will only be needed as the old paint is destroyed through age and weather. Painting on account of discoloration caused by seepage will be eliminated. In the refineries, where tanks are painted white, the saving in the paint bill will amount to considerable. The saving in crude oil over a period of years by the use of these absolutely tight tanks will run into large amounts. The savings in volatile liquids from evaporation, seepage and leakage, can hardly be estimated, and will, over a period of years, run into large sums of money.

Following are descriptions of the methods of constructing a number of different storage tanks by electric welding:

100 Barrel Tank

9 ft. diameter, 9 ft. high of 5.5 lb. plate (10 gauge).
1½ in. laps throughout, welded from one side only.
No chipping and caulking.
The bottom and top are in two halves.
The shell in six vertical plates.
The plates rolled to shape.
The plates punched for bolt holes.
Two bolt holes every 30 in. and at the corners.
Welded with .134 in. diameter electrodes.
Current value about 125 amperes.
Average speed downhand welding 9 ft.
Average speed vertical welding 4 ft.

These tanks are erected by suspending an angle iron ring above the tank with six small blocks to catch each of the vertical plates and to hold them in place for bolting up and fastening to the bottom. Next, the top is put into place and bolted up. The tank is then laid on a cradle in a horizontal position and welded throughout from the outside only. The tank is turned so that all vertical seams of the finished tank are welded in a down hand position, as well as the cross seams of the top and bottom. Leaving the tank on the cradle, the tank is turned as the work progresses. The circumferential joints between the top and shell, and the bottom and shell are welded in a vertical position, as are the fittings. The bolts are left in the tank and are welded to the tank from the outside.

500 Barrel Tank

15 ft. diameter, 16 ft. high of 5.5 lb. plate (10 gauge) blue sheet steel.
1½ in. laps throughout, welded from both sides, excepting foot, which was welded from one side only, to make it gas tight. No strains on the roof.
Size of sheets, 4x11 ft.
No chipping and caulking.
The bottom and top are in three courses.
The plates were *not* rolled to shape.
Six bolt holes.
Welded with .134 in. diameter electrodes.
Current value, 125 amperes.
Average speed downhand welding, 10 ft. per hour.
Average speed vertical welding, 5 ft. per hour.

The bottom plates laid out flat on the foundation, which was graded in the usual way and welded from one side. After this was complete, the bottom was turned over and welded from the other side.

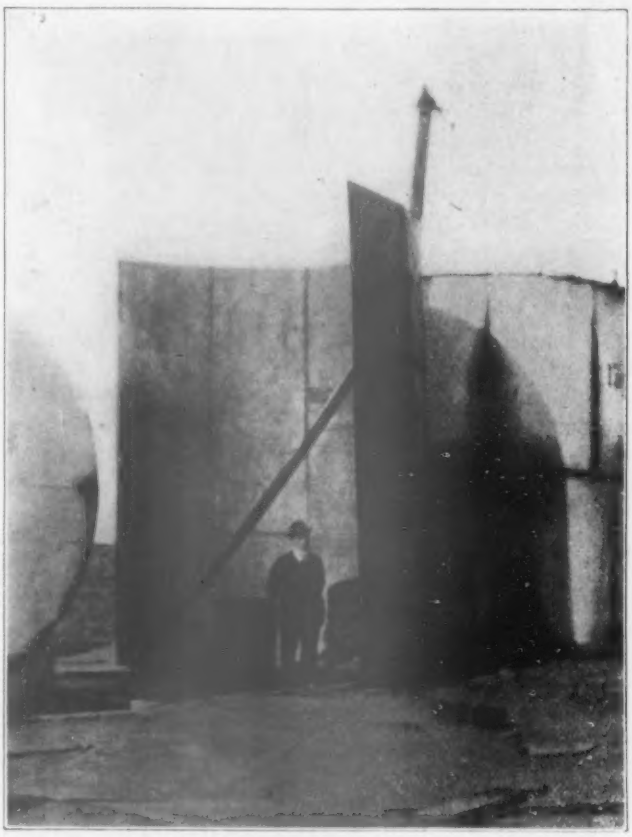
The shell was made in a different way from the ordinary procedure. Instead of being built in several courses it was built in one single course, giving only vertical seams in the shell, on a barrel stave idea.

The plates of the shell were laid out and welded together flat on the ground, so as to make two halves. One-half of the shell was then raised by means of a gin pole and one corner of it tack-welded to the bottom.

The ends of a turn buckle were fastened to the outside ends of this half of the shell about half way up, by means of lugs that were welded on to the shell. By lightening this turn buckle the shell was forced into place and tack-welded as it got into the proper position on the bottom.

The other half of the shell was raised in a similar manner and tack-welded into position.

This left the upper part of the shell out of shape. A cable loop was then put around the top of the shell. By tightening this the shell was forced together.



Section of 500 Barrel Tank.

A 6-inch I-beam on edge, specially prepared with bolt holes and the web removed in way of the bolt holes, was fastened to the outside of the shell along the length of the vertical shell seam. A similar I-beam was fastened on the inside of the same seam.

There were three holes in each of these I-beams, and corresponding holes in the shell of the tank. With these I-beams, the edges of the shell were forced into position and welded.

After the vertical seams had been welded outside, the I-beams were removed and the inside vertical seams welded up.

These bolt holes, which were the only holes in the whole tank were then welded up. The joint between the bottom and the shell was made by setting the shell on the bottom, and consisted of one inside and one outside weld without any angle iron. The outside weld being the heavier.

A 2x2x¼-inch angle iron was welded all around the top of the shell, heel and toe.

The roof was welded in three courses. The ends of the center course were slit in the middle, a V-shaped piece being cut out at each end. A 12-inch high block was put under the middle of the center course, which gave the roof the proper pitch and in this position the slits were closed and welded. This course was then put in place and welded to the top angle and the other courses lapped to the center course and welded to it and the top angle. There was no frame under this roof.

The fittings were welded in the ordinary way.

The tank was filled with kerosene on completion and found absolutely tight without a leak or sweat of any kind and has been in constant use for seven months.

A number of similar tanks have been successfully welded.

5,000 Barrel Tank.

43 feet diameter, 20 feet high.
Bottom of 5/16-inch plate.
First course ¼-inch plate.
Second course 5/16-inch plate.
Third course 11/32-inch plate.
Fourth course 3/8 inch.
Roof 5/16-inch plate.
Size of shell plates 5x14 feet.

1½ inch laps throughout, welded from one side in top and bottom, from two sides in the shell, the heavier weld being on the outside and in downhand position.

No chipping and caulking.
The plates were rolled.
Bolt holes every 36 inches.
5/16-inch plate and over welded with .165-inch dia. electrodes.
Current value about 145 amperes.
Plates under 5/16-inch welded with .134-inch dia. electrodes.
Current value 125 amperes.
Average speed down hand welding 8 feet per hour.
Average speed vertical welding 4 feet per hour.

This tank was erected according to the standard for riveted tanks, in courses and each course was bolted together before being welded, by bolts every 3 feet.

A 2x2x¼-inch angle iron was laid on the bottom along this outside edge, leaving a ¼-inch space between the angle and outside edge of the bottom. The bottom flange of angle was welded to bottom.

The first course set on the bottom and backed against the angle and course welded to the bottom all the way around the side by a ½-inch weld. The angle welded to this course from the inside of a ¼-inch weld.

A 2-inch lap between each two courses.

The outside welds were made for strength. The inside welds to seal the joint between the two plates.

The plates were scarfed where three plates came together.

The joints were simply welded in the ordinary way.

The top angle 2x2x¼-inch was welded heel and toe all around.

The roof was of the ordinary type of steel roof with a center and radial plates.

The angles and I-beams and roof construction were all welded in the simplest way, according to common practice, developed in structural welding work.

Welding on Large Tanks. From the amount of work done up to date, it has been definitely established that the same procedure can be followed in the construction of any size of tanks.

* * *

Acid Tank.

Acid tanks of various kinds are being welded.
One acid tank was just completed.
10 feet diameter, 15 feet high, 7/8-inch plate (slide).
Bolt holes every 36 inches.
Plates rolled to shape.
About 3 feet welded per hour.
Welded from the outside with a light sealing weld from the inside.

* * *

Agitator

24 feet diameter, 30 feet high.
Cone top and bottom.
All joints inside butted. All outside joints butt-strapped.
Bolt holes every 3 feet.
Welded from the outside only.
Butt joints welded from the inside.
The plates in courses, rolled to shape.
Welded with .165 diameter electrodes.
Current value 125 amperes.
Bottom cone ½ inch.
Shell 3/8 inch, 5/16 inch.
Top ¼ inch.
Estimated time, average 4 feet per hour.

WELDED RAIL JOINT COMMITTEE ORGANIZED

At the request of the American Electric Railway Association, the American Bureau of Welding has undertaken to organize a committee on Welded Rail Joints for the purpose of having an authoritative investigation made of the various types of welded rail joints now in commercial use. Welding is being very widely used in making street railway joints and more or less trouble has been experienced in all types of welded joints from breakage. Little or no scientific data exists as to the correct procedure to follow in making welds by the various processes. Several of the larger companies are spending over a hundred thousand dollars per year on such joints.

A preliminary organization meeting was held on June 9th at the office of Director C. A. Adams and a plan for the organization and conduct of the work was outlined.

The present plans are to organize a relatively large committee, including representatives of users, consumers and also the best technical experts in the field. A number of replies accepting membership have already been received from the larger railway companies. As soon as the organization of the committee is complete, a meeting will be called to consider the following points:

(a) Preparation of a bibliography and critical summary of our present knowledge, including the gathering together of all available experience in this field.

(b) Consideration of the result of (a) and the laying out of specific experiments to be performed.

(c) The assigning of each of these experiments or researches to an appropriate laboratory or in the case of field experiments to one or more appropriate operating companies. These assignments would, of course, cover the men under whom these specific experiments will be conducted.

Mr. E. M. T. Ryder, Way Engineer, Third Avenue Railway Company, has been elected to serve as temporary chairman until the full or part time services of a prominent engineer can be secured. Mr. Wm. Spraragen, Secretary of the American Bureau of Welding, is also acting as Secretary of the committee.

WELDING IN SHIP CONSTRUCTION

With the extensive development of electric and oxy-acetylene welding and their applications in the engineering industry during the last two or three years of the war, it is natural that shipbuilders, faced with the necessity of increasing production and maintaining costs at as reasonable a figure as possible, are giving attention to welding both as a supplement to and a substitute for riveting. Most of us are already familiar with the varied applications of welding in ship repairs, such as boiler repairs, worn parts and plates, cracks in fireboxes, broken stern frames, etc. Moreover, welding is extensively used in the construction and assembly of a large number of important parts on the ship.

Electrically Welded Ships

The Electric Arc Welding Committee of the American Welding Society, under the chairmanship of Mr. H. M. Hobart, reports that a new stimulus has been given to the use of electric welding in ship construction. The experience gained in ship repair work and the improved technique of the

art during the last three years had the effect of attracting the attention of shipbuilders to electric welding as a method of ship construction. It was obvious that provided welding was capable of effecting a joint between ship's plating, equal to riveting in strength and ability to withstand the complex stresses imposed on the joints of a ship's structure, there was no doubt that it would show considerable economy in labor and material. The tests that were carried out convinced shipbuilders that it was not only possible to effect a stronger junction by electric arc welding than by standard riveting and that considerable economy in material was effected with welded joints owing to the reduction in width of laps and butt straps, but also the additional advantage of the welded joint was demonstrated by the fact that while the welds remained watertight up to their ultimate strength the riveted joints opened at the calking on the application of very little stresses. It is interesting to know that seven all-electrically welded ships are now in existence, a more detailed statement of which is given below:

Covered Electrodes

No. 1. A Swedish boat launched last December at the works of the Electric Welding Company, Gothenberg. The dimensions of the boat are: Length, 52 ft. 6 in.; breadth, 13 ft.; molded depth, 7 ft., and draft, 3 ft. 6 in. The ship is of the flat bottom type and the sides are smooth as if cast from one piece, butt welded joints having been used. The ship has 5,655 ft. of welding of various thicknesses of metal.

No. 2. A slightly larger boat of construction similar to the above was built at Caen, France, in 1919.

No. 3. In June, 1918, the British Admiralty constructed an electrically welded cross channel barge and its success in service has already attracted considerable attention. This barge is 200-ton dead weight with a length between pendiculars of 126 ft., molded breadth 16 ft. 4 in. and depth molded 7 ft. 9 in. The vessel has a flat hull.

No. 4. The electrically welded ship "Fullagar," constructed by Messrs. Cammel, Laird & Co., Ltd., and launched in February, 1920, is a coaster 150 ft. long by 23 ft. 9 in. beam and 11 ft. 6 in. deep to the main deck. The draft is 11 ft. 4 in. and the dead weight is about 500 tons. When the plates were joined end-on a butt weld with a strap behind was mostly used. A similar construction was used for the joints between keel plates and the larboard plate. The lap welded joint is used in shell plating. Where joints are not required to be watertight, the welding is done in short lengths with unwelded spaces between, the welds being placed alternately on either side of the frames.

Bare Wire Electrodes

No. 5. In 1915 an all weeded American boat was launched at Ashtabula Harbor on Lake Erie. The dimensions of the craft are: Over-all length, 42 ft.; beam, 11 ft.; molded depth, 6 ft. 6 in.; draft, 40 in. The hull plating was butt welded in contrast to the lap welding adopted by the English cross channel barge. The boat is still in continual service on Lake Erie and none of the welds show any sign of weakening despite the fact that on more than one occasion the launch has acted as an icebreaker with ice 4 in. to 8 in. thick, besides having been badly crushed between two ore lighters.

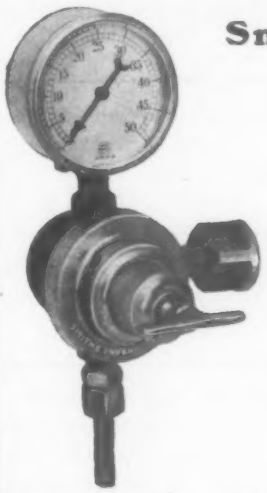
No. 6. A battle towing target 172 ft. in length was constructed at the Norfolk Navy Yard. The total length of welding was approximately 5,040 ft., most of which was done in a flat position. A detailed description of the target, including a discussion of tests, costs, advantages, etc., was given in the December, 1920, issue of the Welding Engineer

(Continued on page 55)

SMITH'S

The Welding Line That IS Complete

The completeness of Smith's Oxy-acetylene and Oxy-hydrogen Welding and Cutting Equipment is the result of an intensive and exhaustive study of the welder's needs. No item or accessory has been overlooked—even to the smallest adaptors and connections.



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Furnished for Oxygen, 50 lbs. or Acetylene, 80 lbs.

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Help Wanted—75c per line, minimum 4 lines.
Jobs Wanted—4 lines free.
Other Ads—$1.00 per line, minimum 4 lines.
Counted 8 words to line. Add 6 words for keyed address.

Position Wanted—Oxy-acetylene welder of exceptional ability wishes to connect with a reliable firm in need of the services of a man capable of handling such a department. Address 1, care The Welding Engineer.

Position Wanted—All around Oxy-acetylene welder wishes to make connection with a reliable concern. Willing to work anywhere but Chicago positions are preferable. Specialist on steel. Can handle shop. Address 2, care The Welding Engineer.

Position Wanted—Efficient welder capable of running shop and handling men wishes position. Nine years' experience in light and heavy work. Well recommended. Address 3, care The Welding Engineer.

Wanted—First-class oxy-acetylene welder with aluminum and automobile experience for job shop. International Welding Co., 14th and Wazee Streets, Denver, Colo.

Position Wanted—Experienced welder able to handle a shop or to work and shop where big work is done. Nine years of welding during which time all kinds of metals were repaired under my torch. Address Thomas J. Blair, 20 Montgomery Street, Poughkeepsie, N. Y.

Beginners' Greatest Problem—Expert oxy-acetylene welding and auto radiator repairing taught in your own shop on a 50-50 basis plus $100 and traveling expenses. Can give reference. John F. Wrassee, Box 246, Frederick, Okla.

The two-story building owned by the Merchant & Evans Co., at Twenty-first Street and Washington Avenue, Philadelphia, has been leased by the Reid-Avery Co., 1434 Brandywine Street, same city, for the operation of an electric arc welding and repair works.

The John Roebling's Sons Co., Trenton, N. J., manufacturer of wire rope and other wire products, are planning a 500 by 850-foot, two-story addition for the production of copper and other wire.

John Fox Weiss and Elmer R. Erb, Harrisburg, Pa., are organizing the Harrisburg Machine & Electric Welding Company, Harrisburg. Manufacture of machinery and parts and the operation of a general repair works, is planned.

TECHNICAL PROCEEDINGS FOR OCTOBER, 1921, MEETING OF THE AMERICAN WELDING SOCIETY

The topics selected for inclusion in Proceedings for the October meeting of the American Welding Society are scheduled as follows:

1. Welding Historically Reviewed—President S. W. Miller.
2. Welding Society Membership—Charles A. McCune.
3. Welding Society Administration—Acting Secretary M. M. Kelly.
4. Necrology—Herman Lemp.
5. Finances—Treasurer W. E. Symons.
6. American Bureau of Welding and National Research Council—Prof. Comfort A. Adams.
7. The World's Welding Work.
8. Shipbuilding.
9. Locomotive Work.
10. R. R. Construction.
11. Bridges and Buildings—Structural Work.
12. Cars and Vehicles.
13. Pipes and Conduits.
14. Sheet Metal Work.
15. Plant and Equipment Maintenance.
16. Tanks and Boilers.
17. Thermit.
18. Commercial Gases.
19. Gas and Arc Welded Seams.
20. Graphite and Carbon.
21. Metallurgy and Chemistry.
22. Arc Welding.
23. Automatic Welding.
24. Resistance Welding.
25. Preheating and Annealing.
26. Cast Iron and Manganese.
27. Non-Ferrous Metals.
28. Wire.
29. Production Cutting—Gas or Arc.
30. Welding Accessories.
31. Welding Plant Installation.
32. Training and Compensation.
33. Inspection and Tests.

AMERICAN GAS ASSOCIATION CONVENTION SEES ROSY FUTURE

Optimism for the immediate future and a general revival of business activity for the industry is to be the keynote of the third annual convention and exhibition of the American Gas Association, the national organization of the manufactured gas industry in this country, which will be held in the Congress and Auditorium Hotels, Chicago, November 7 to 12.

More than one hundred manufacturers will exhibit their latest gas-burning appliances and the business sessions of the convention will draw an audience of gas men estimated at 1,500.

Reports coming into Association headquarters show that when the general business situation improves there will be a tremendous jump in the demand for gas service. The industry is now making engineering and financial plans to meet this anticipated demand.

LIBERTY ALUMINUM SOLDER permanently repairs Crank Cases, Aluminum auto hoods, auto bodies, manifolds—in fact anything made of aluminum. Guaranteed to give satisfactory results. Laboratory test shows 12,000 pounds tensile strength. Price $2.00 the pound, 10 pounds or over $1.75. Shipment cash with order or C. O. D. except where satisfactory credit relations established.

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174 West Third Street, St. Paul, Minn.

WELDING IN SHIP CONSTRUCTION

(Continued from page 53)

under the Proceedings of the American Welding Society in a paper by Messrs. J. W. Owens and H. G. Knox.

No. 7. A self-propelled barge is being constructed by electric arc welding with bare electrodes by the SOS Welding Corporation of Brooklyn. The dimensions of this barge are: Length, 52 ft.; beam, 15 ft.; depth, 7 ft. One-quarter inch plate with both lap and butt welds are being used. The construction of the hull is of the modified V-bottom type.

Conclusions: In general the advantages of electric welding for ship construction may be summarized as follows:

(1) With the elimination of marking off, drilling or punching, countersinking and calking, a considerable economy in time and labor can be effected.

(2) By the reduction in width of laps and size of butt straps a saving of from 5 to 10 per cent of material can be effected.

(3) Welded joints can be made that will withstand greater stresses than similar riveted joints and can be made equal in strength to the ship plating.

(4) Once the practice is standard a reduction in the weight of the shell plating will be possible without reducing the safety factor.

(5) A welded joint is oil and water-tight up to its breaking point, whereas riveted and caulked joints are liable to leak badly at as low as 25 per cent of their ultimate strength.

WHERE WELDING IS HOT WORK

Welders who think that their work has been hot during the recent hot wave can consider themselves lucky that every place is not as hot as Honduras. The Buckeye Welding & Supply Co., of Cleveland, recently sent a demonstrator to La Lima, Honduras, for the Dyer Company of Cleveland, builders of sugar refineries. "Charley" did the job, alright, but he had a hot time doing it, as evidenced by the following reports to Mr. Martin of the Buckeys Company.

La Lima San Pedro Sula, Honduras, C. A., May 12, 1921.

Mr. S. A. Martin,
c/o The Buckeye Welding & Supply Co.,
1544-52 West Sixth Street,
Cleveland, Ohio.

Dear Sir:

Finally arrived in Puerto, Cortez, Sunday, May 1st, and reached the plant at La Lima, Monday evening. Tuesday, the 3d, I started on the job and finished the first belt yesterday.

Each section weighs approximately four ton, so you can readily see what I am up against, with gangs of natives and light chain blocks to work with. After chipping the casting I tried to make a vertical weld, but not having any carbon blocks, I was not successful. Incidently, I had a streak of bad luck. My acetylene line blew out and caught fire; result, a pair of badly burned arms, which laid me up for a couple of days. Finally I decided to fasten it with a couple of planks and turn it on end. By that time I had found a man who knew a little about welding and induced Mr. Pheling to let him work with me.

As they had no charcoal down here, we built a fire with wood and coke under the break and started in the center and worked toward one end and back again to the center and back to the other end, finishing about 7:30 that evening. This morning everything looks fine, the tram marks check up perfect so I have decided that it is O. K.

This all probably sounds good to you, but believe me, as far as heat is concerned it resembles a spot that starts out like Heaven, but ends far from there. The thermometer registers around 120° and it got so hot that we had to build a roof over the casting. From 1:00 until about 3:00 P. M. it is utterly impossible to work, so we build the fire under it and leave it toast. Without exaggeration, it is impossible to lay a wrench down in the sun and pick it up a half hour afterwards with your bare hand. Between 3:00 and 4:00 in the afternoon a cool breeze that is a life saver blows up and is fairly comfortable to work in until dark.

After dark one doesn't care much to go out, as the mosquitoes are very thick, to say nothing of the flies and ticks. Evenings are quite cool, and it is surprising the amount of covering that a person needs while sleeping.

Bunk houses are extremely well laid out and very sanitary. Practically all of our meals are made from canned goods, and, as a rule, we have fried bananas instead of potatoes. One thing, however, brings back fond memories (?) of the army days, and that is, three times a day frijole beans, and believe me, when I get back to the States I don't want to see bananas or beans again for some time.

If I have any luck I expect to finish the next belt the latter part of next week; and if I do, you can expect me back in Cleveland within a month.

They don't seem to get newspapers down here, so I will appreciate your dropping me a few lines with bits of current news.

Yours very truly,

CHARLEY.

La Lima San Pedro Sula, Honduras, C. A., May 17th, 1921.

Mr. S. A. Martin,
c/o The Buckeye Welding & Supply So.,
1544-52 W. Sixth Street,
Cleveland, Ohio.

Dear Sir:

Just finished the second belt today, and I hope that it is the last one. There is quite a little more small welding, and I expect to finish that within the course of the next week or ten days.

I have taken several rolls of pictures, but as I am not much of a hand at photography, I can do little more than hope that they turn out O. K.

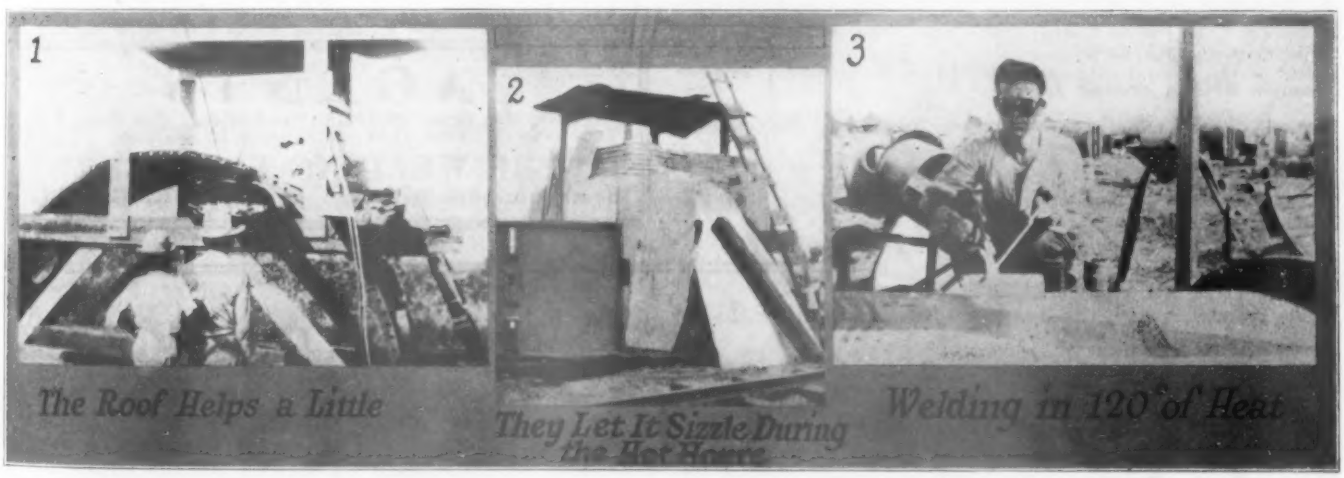
It is still as hot as—ever, and I sometimes wonder how some of the white men can stay here for years. Last Saturday two or three of us took a trip to San Pedro to look the town over. Went down on our private cars (flat cars). There is very little to see there other than the bar rooms and boy, they are something to wonder at, Old Scotch, Canadian Club, etc., at $2.00 a quart. Beer that AM BEER at 50 cents a bottle. As I never indulge, naturally I wasn't interested, but thought that the news might be of interest to some of you members of the Cleveland Oasis. (?)

The Hondurian Army has its headquarters here, and its a sight for sore eyes. Practically all of them are barefoot, and no two with uniforms alike. I should judge from the condition of the buildings that the Old Boys must be pretty wild when it comes to shooting. The town is not very large, and they tell me that during that last revolution over 400 were killed in this city. Souvenirs are plentiful down here, but most of them are made in the United States. Good hats cost you about $12.00. Good cigars at three cents apiece, and they also have what we call drift pins at one cent each. However, after three of the one-cent variety, a man is ready for battle.

The oil in my lamp is getting low, also my news, and as the lamp is a good mosquito playground, I had better quit for the night. Regards to all the boys at the plant, and trusting to be back in the good old U. S. A. soon, I am,

Yours very truly,

CHARLEY.



A Welding Job in Honduras. The Sun is almost Hot enough to Preheat the Job.

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Office and Factory: 27 South Jefferson St., Chicago, U. S. A.

CURRENT WELDING LITERATURE

WELDING WIRE FOR MILD STEEL:—A brief argument over the merits of Swedish iron for welding mild steel.—Acetylene and Welding Journal, London, August.

SIDE LIGHTS FROM A CONSTRUCTION CAMP, by J. C. Blake.—Oxy-acetylene welding an essential to the modern construction camp. Welding in construction of huge California hydro-electric development.—Acetylene Journal, September.

ACETYLENE GENERATORS, by David Baxter—Instructions on the care of generators and precautions to be taken.—Acetylene Journal, September.

STANDARD SAFETY CATALOG—Catalog of safety equipment and supplies, including welding goggles, asbestos gloves and clothing, welding and cutting torches, and oxygen and acetylene regulators. Published by Standard Safety Equipment Company, Chicago.

A WELDED LOCOMOTIVE TENDER TANK, by J. W. Murphy.—Details of the construction of an 8,000 gallon tender tank by arc welding. The welding method eliminates the punching of rivet holes and promises a reduction in maintenance costs.—Railway Mechanical Engineer, September.

WELDING AND CUTTING, by Fred E. Rogers.—Instructions for the care and use of oxy-acetylene apparatus and equipment. 96 pages, bound in paper. Contents: Setting up Welding and Cutting Equipment; Learning to Weld; General Welding Practice; Boiler and Tank Welding; Welding Machines; Oxygen Cutting; Mechanically Operated Cutting Torches; Generation of Gases. Price, $1.00. Published by Davis-Bournonville Co., Jersey City, N. J.

THE STRENGTH OF WELDS—The Comité de la Chambre Syndicale de la Soudure Autogène, France, noticing that the liquidation of war stocks was leading to the sale of great quantities of welded cylinders made during the hostilities for carrying asphyxiating gases, took steps to prevent the use of such tanks for transporting industrial gases. A series of experiments showed that the tanks in question had not been properly welded but that they could be rewelded so as to give satisfactory service.—Revue de la Soudure Autogene, July-August.

TYPES OF WELDS, by W. B. Purdue—Potentialities of the process. Melted steel. Heat treatment. Flanged welds and fillet welds.—Canadian Welding Journal, July.

WELDING A TRANSMISSION CASE, by David Baxter—American Blacksmith Auto and Tractor Shop, July.

DON'T THROW IT AWAY, by Harold F. Blanchard—Some striking examples of large savings effected by welding seemingly worthless parts.—Motor, August.

TWO RAILROAD CONTRACTS FOR WELDING APPARATUS

An encouraging sign of business revival is found in two large contracts for oxy-acetylene welding and cutting equipment recently placed by the Baltimore & Ohio Railroad and the Western Maryland Railroad with the Alexander Milburn Co., of Baltimore, Md. These railroad contracts indicate a renewal of purchasing activity among the railroads, at least on equipment that has demonstrated cost economies in operation.

GENERAL ELECTRIC COMPANY EXHIBITS AUTOMATIC ARC EQUIPMENT AT CHICAGO PAGEANT

During the Pageant of Progress held at Chicago, recently, the General Electric Co. exhibited its automatic arc welding outfit. The machine comprises necessary fixtures for feeding a bare metallic electrode wire to a welding arc at the rate required to hold a constant arc length. Suitable mountings and adjustments are provided throughout the device.

Colonel Washington A. Roebling, for many years vice-president of John A. Roebling's Sons Company, Trenton, N. J., has been elected president, to succeed his nephew, Karl G. Roebling.

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Because many of the readers of *The Welding Engineer* are interested in the Automotive industry the publisher of *The Welding Engineer* has pleasure in announcing *The Automotive Electrical Engineer,* a new monthly publication which will be devoted exclusively to Starting, Lighting and Ignition.

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The Automotive Electrical Engineer will be run exactly like *The Welding Engineer.* In other words the subscriber and the advertiser will get a run for their money. If you are interested send me your subscription on approval.

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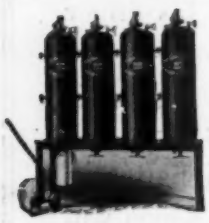
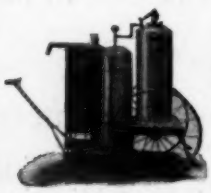
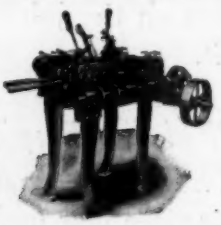

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THE WELDING ENCYCLOPEDIA

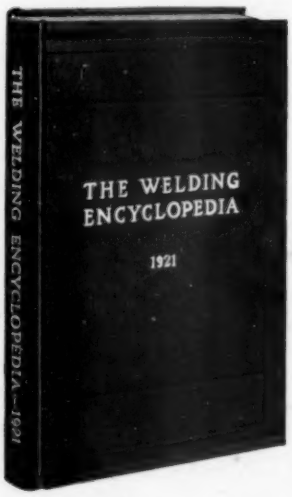
—Judged by the Technical Leaders of America

Below are reproduced excerpts from reviews of The Welding Encyclopedia which have appeared in the leading technical and engineering trade journals of the United States, publications whose editorial pages voice the most authoritative and progressive thought which our industrial world knows.

"A very complete reference and instruction book covering the fields of electric, gas-torch, and thermit welding." —American Machinist.

"Prepared to supply those interested in welding with a collection of definitions and explanations of the principal operations." — Iron Trade Review.

"Contains a wealth of practical information on welding and should find a wide and useful field in the advancement of the art of making welds."—Power.



"Furnishes at once a complete reference and instruction book on autogenous welding by every variety of method."—Railway and Locomotive Engineering.

"Brings together . . . a wide range of knowledge concerning welding practice, equipment and auxiliary appliances for all classes of work." — Railway Signal Engineer.

"A complete reference and instruction book on the subject of autogenous welding by every method."—The Welding Engineer.

The road to mastery of your craft lies through the acquisition of complete knowledge of it. The Welding Encyclopedia deals fully and impartially with every welding process. It grows more and more valuable through constant use. It replaces guesswork by scientifically directed effort. Every welder should own and use this book.

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